Town of Hingham
Groundwater Protection Study

Metropolitan Area
Planning Council

110 Tremont Street
Boston, Massachusetts 02108

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HINGHAM
GROUNDWATER PROTECTION STUDY

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METROPOLITAN AREA PLANNING COUNCIL
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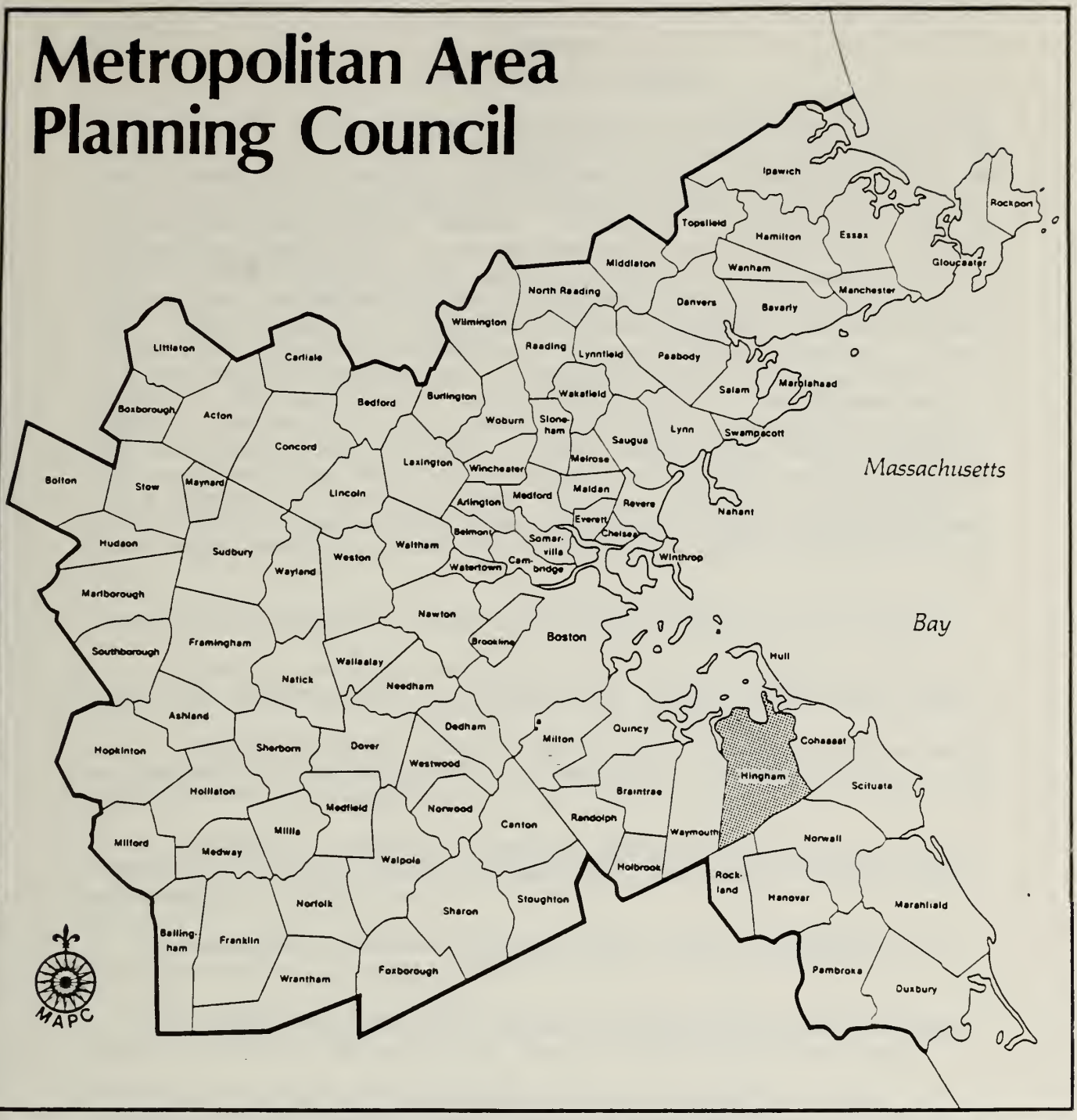


HINGHAM GROUNDWATER
PROTECTION STUDY

Regional Location Map

4 2 0 4 8 12

Scale in Miles

CHAPTER 1
BACKGROUND AND SUMMARY

This technical assistance report was prepared at the request of the Town of Hingham, whose officials have expressed an interest in protecting the town's water supply sources. Hingham meets most of its water supply needs with local sources of groundwater, supplied through the privately owned and operated Hingham Water Company. In 1981 MAPC prepared Protecting the Accord Pond Water Supply, which recommended protection measures for the surface water component of the town's water supply. As a result of that report, the town adopted the Accord Pond Watershed Protection District in 1983. This groundwater protection study was prepared to extend similar protection to the remainder of the town's water supply sources. It should be noted that the water sources in Hingham are also the sole source of supply for the town of Hull, which is also served by the Hingham Water Company. The study area for this report includes the watershed within the Weir River basin which contains the town's water supply wells. Within this watershed there is a sand and gravel aquifer which supplies the six wells operated by the Hingham Water Company. Since all land uses and polluting activities within the watershed could potentially affect the water supply sources, the watershed boundary was used to define the study area.

The overall methodology of this study included the following steps:

- o inventory the water resources of the town and identify areas of particular significance to the quantity and quality of the water supply;
- o inventory existing land uses and potential sources of groundwater contamination in the study area, and assess their potential threat to the quality of the water supply;
- o analyze the zoning of undeveloped land within the study area and determine the extent to which new permitted land uses could affect the water supply in the future;
- o identify and evaluate existing local, state, and federal water resources protection measures; and
- o recommend additional water supply protection measures to mitigate the potential land use and zoning impacts identified in the study.

All of the findings and recommendations were reviewed by a town Groundwater Study Committee which met throughout the course of the study and provided valuable information and guidance. The committee is comprised of representatives of the Board of Selectmen, the Water Supply Committee, the Planning Board, the Board of Health, and the Conservation Commission. A representative of the Hingham Water Company also participated on the study committee, and provided valuable assistance to the study.

Protection of the water supply sources is vitally important in Hingham because all drinking water comes from local sources, and there are few if any practical alternative supply sources available to the town. Other towns in the region have experienced contamination and supply shortages, and the Massachusetts Water Resources Authority cannot be considered an alternative. Hingham's ability to remain self-sufficient in water supply may depend upon how the town manages existing and future development in its water supply watersheds. Hingham has a number of policies which currently contribute to the protection of the town's water supply sources. For example:

o the Hingham Water Company owns about 230 acres of land around its regular production wells, and the town of Hingham owns about 250 acres of conservation land in the vicinity of the wells.

o the town's zoning bylaw includes a floodplain overlay district;

o the town has a watershed protection bylaw for the Accord Pond watershed.

This study has examined land uses, zoning, and regulations in the town and has identified areas requiring additional protection to insure the long term quality of the groundwater resources. This has led to a set of recommendations for augmenting and strengthening town policies and regulations for managing activities within the watersheds. The major elements of this program include:

o a zoning amendment to establish an Aquifer Protection District over the aquifer which supplies the Hingham Water Company wells;

o adoption of an underground fuel storage bylaw, which would strengthen existing regulation of the location, installation, and maintenance of underground fuel tanks;

o an amendment to the earth removal regulations requiring that excavation be no deeper than ten feet above the seasonal high water table;

o amendments to the town's Health Regulations to strengthen their requirements for septic systems; and

o amendments to the subdivision regulations to require review of potential groundwater impacts.

Implementation of the recommended program will require the cooperation and

support of several town boards, as well as town meeting support for new or amended bylaws. An important element for successful implementation will be public education. The Groundwater Study Committee may assist in these efforts, which may include public meetings and presentations, as well as development of brochures or other educational materials. Increasing public awareness of groundwater protection will be as important as modifying local regulations in meeting the goals of the groundwater protection program.

In the chapters that follow, the background, analysis, and the recommended plan are presented in detail. It is hoped that this study will assist the town of Hingham in the development of a comprehensive water supply protection program.

CHAPTER 2
WATER SUPPLY SYSTEM PROFILE

Prior to examining the protection needs of Hingham's groundwater resources, it is useful to have an overview of the elements and operation of the water supply system. This will aid in formulating a protection plan which is responsive to the needs of the town.

WATER USE AND CONSUMPTION

The Hingham Water Company supplies water to about 18,500 people in Hingham, or about 90% of the population. An additional 11,000 in Hull and Cohasset are also supplied. There are about 10,000 service connections in the three-town service area, 6300 of which are in Hingham. In 1985 the system delivered a total of 1.17 billion gallons, with an average day demand of 3.2 million gallons per day (mgd) and a maximum day demand of 5.8 mgd. Water use falls into the following major categories:

Residential	65%
Commercial	12%
Industrial	2%
Other (government, etc.)	5%
Unaccounted-for	16%
Total	100%

Over the last 15 years, average day demand has fluctuated between 3.1 and 4.1 mgd, generally increasing to a peak of 4 mgd in the late 1970's, and subsequently declining in the 1980's (see Table 2-1). Peak demand reached a high of over 7 mgd in 1980 and 1983. This exceeds the current system safe yield of 6.8 mgd.

TABLE 2-1 HISTORIC WATER USE

YEAR	AVERAGE DAY (mgd)	MAXIMUM DAY (mgd)
1985	3.20	5.84
1984		
1983	3.68	7.03
1982	3.63	6.68
1981	3.83	6.04
1980	3.87	7.13
1979	4.00	6.72
1978	4.04	6.75
1977	4.09	6.73
1976	3.58	6.58
1975	3.67	6.41
1974	3.38	5.54
1973	3.26	5.23
1972	3.13	5.20
1971	3.19	6.06
1970	3.10	5.69

Projections of future demand made by the Hingham Water Company estimate that by the year 2000, average day demand will be 4.5 mgd and maximum day demand will be 8.5 mgd. (See Table 2-2).

TABLE 2-2
HINGHAM WATER COMPANY
FUTURE DEMAND PROTECTION

Year	Average Day MGD	Maximum Day MGD
1990	4.27	8.11
1995	4.42	8.41
2000	4.51	8.56

WATER SUPPLY SOURCES

The Hingham Water Company relies upon surface water and groundwater sources which have a combined safe yield of 6.8 million gallons per day. Groundwater is a major source of public water supply in Hingham. The Hingham Water Company operates five gravel pack wells with a combined safe yield of 4.3 mgd (see Table 2-3). This represents 63 percent of the company's supplies. In addition 2.5 mgd is available from surface water supplies, including Accord Pond and Accord Brook, which are pumped through Fulling Mill Station. (See Table 2-4.) An additional well, Free St. No 4, has been constructed, but it cannot be used until the Free St. Treatment Plant is constructed. This well could add an additional 2 mgd to the system.

TABLE 2-3
HINGHAM WATER COMPANY WELLS

	Safe Yield (mgd)	Size	Depth	Year Installed
Scotland St.	1.0	18"	45'	1956/78*
Prospect St.	0.5	18" x 24"	58'	1971
Downing St.	0.5	24" x 48"	66'	1966
Free St. #2	2.0	24"	71'	1951
Free St. #3	0.3	24"	88'	1968/76*

* Second date indicates well redevelopment

TABLE 2-4
HINGHAM WATER COMPANY WATER SOURCES

Source	Safe Yield (mgd)	Percent of Total
Scotland St.	1.0	15
Prospect St.	0.5	7
Downing St.	0.5	7
Free St. #2	2.0	30
Free St. #3	0.3	4
Subtotal-Groundwater	4.3	63
Fulling Mill	2.5	37
SYSTEM TOTAL	6.8	100%

EMERGENCY SOURCES

There are no emergency sources readily available to the town. The town of Cohasset has offered to sell some of its surplus water to the Hingham Water Company over the next five years; however, after that time Cohassset anticipates that it will not have a surplus available. The town is not able to receive water from the Massachusetts Water Resources Authority system. The lack of alternative supplies underscores the need for Hingham to maintain its water supply self-sufficiency through management and protection of its local water resources.

POTENTIAL FUTURE SOURCES

The planned Free Street Station Treatment Plant will increase the town's source of supply since the plant will allow the use of Free Street well No. 4 and additional surface water such as Accord Brook. The Hingham Water Company projects the system safe yield to increase from 6.8 mgd to 10.3 mgd when the plant comes on line.

In order to explore for new water sources, the Hingham Water Company has conducted a test well drilling program. To date, the exploration has yielded no promising results. the lack of additional supplies underscores the importance of protecting the existing sources of supply.

WATER QUALITY

The quality of the raw water sources in Hingham is such that treatment is required for all sources. One of the most persistent problems with Hingham's groundwater is the high level of manganese. This is a naturally occurring mineral, and its presence does not indicate contamination due to human activities. Currently all the groundwater sources receive treatment for manganese with hexa-metaphosphate. Despite this treatment, the water from all the wells except Prospect Street exceed the Safe Drinking Water Act standard for manganese by a factor of up to twenty times the standard. However, this problem will be alleviated by the new Free Street Station Treatment Plant when it comes on line. It should also be noted that manganese, which discolors the water, is considered an aesthetic problem, but is not a threat to public health.

The quality of each source of water is tested periodically according to state and federal requirements. Table 2-4 summarizes the results of recent water quality tests for each of Hingham's water sources. The water meets all standards except those for managanese. There is no evidence of chemical contamination of any of the sources at this time. However, many organic chemicals are not currently tested for under state and federal regulations. Recent amendments to the Safe Drinking Water Act require that organic chemicals be tested for beginning in 1987. It should also be noted that the conventional treatment systems operated by the Hingham Water Company are not designed to remove organic chemicals.

WATER TREATMENT

Hingham's drinking water receives a variety of treatment for disinfection, corrosion control, manganese control, and flouridation. The treatment received by each source is summarized in Table 2-5. All sources are disinfected, either with chlorine or hypochlorite. Corrosion control is accomplished with lime or potassium hydroxide at four of the sources. Sodium hexametaphosphate is added to all the groundwater sources to sequester iron and manganese and Free Street No. 2 has a green sand filter for manganese control. The surface water supplies are filtered at the Fulling Mill Station. All sources are flouridated for prevention of tooth decay.

Table 2-6 Water Treatment

	Disinfection & Flouridation	Corrosion Control	Hexa-meta-phosphate (manganese)	Greensand Filter (manganese)	Celite Filter
Scotland St.	X	X	X		
Prospect St.	X		X		
Downing St.	X		X		
Free St. #2	X		X	X	
Free St. #3	X	X	X		
Free St. #4	X	X	X		
Fulling Mill	X	X			X

TABLE 2-4
HINGHAM DRINKING WATER QUALITY

	MCL	SCOTLAND STREET	PROSPECT STREET	DOWNING STREET	#2 FREE STREET	#3 FREE STREET	FULLING MILL
PEST/HERB	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
LINDANE (BHC)	.004	0.0004			0.0004	0.0004	
ENDRIN	.0002	0.0001			0.0001	0.0001	
TOXAPHENE	.005	0.001			0.001	0.001	
METHOXCYHLOR	0.1	0.001			0.001	0.001	
2, 4-D	0.1	0.001			0.001	0.001	
2,4,5,-TP SILVEX	0.01	.00002			.00002	.00002	
MINERALS							
ALKALINITY		40.0	40.0	90.0	58.0	56.0	34.0
CHLORIDE 250		24.8	16.6	14.9	28.2	24.8	53.0
FLUORIDE	1.4-2.	0.12	0.10	0.18	0.21	0.16	0.14
HARDNESS		68.0	50.0	128.0	88.0	38.0	64.0
MBAS	0.5	0.01	0.01	0.01	0.01	0.01	0.01
NO3-N	10	0.70	1.04	3.42	2.40	4.10	1.22
SULFATE	250	23.5	10.7	30.4	31.6	34.5	14.8
TDS	500	136	44	169	192	134	168
TURBIDITY		0.1			0.2	0.1	0.3
METALS							
ALUMINUM		0.018	0.005	0.006	0.076	0.008	0.095
ANTIMONY		1	1	1	1	1	1
ARSENIC	0.05	0.005	0.005	0.005	0.005	0.005	0.005
BARIUM	1.0	0.5	0.5	0.5	0.5	0.5	0.5
BERYLLIUM		0.1	0.1	0.1	0.1	0.1	0.1
BORON		0.2	0.1	0.1	0.1	0.1	0.1
CADMIUM	0.010	0.002	0.0002	0.0002	0.0002	0.0002	0.003
CALCIUM		14.9	13.7	38.1	26.7	22.2	19.7
CHROMIUM	0.05	0.001	0.001	0.001	0.001	0.001	0.001
COBALT		0.1	0.1	0.1	0.1	0.1	0.1
COPPER	1.0	0.02	0.02	0.02	0.02	0.02	0.02
IRON	0.3	0.05	0.13	0.05	0.05	0.05	0.28
LEAD	0.05	0.005	0.005	0.005	0.005	0.005	0.005
MAGNESIUM		7.32	5.08	9.19	6.68	8.11	4.69
MANGANESE	0.05	0.20	0.02	0.46	1.14	0.10	0.22
MERCURY	0.002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0006
MOLYBDENUM		0.5	0.5	0.5	0.5	0.5	0.5
NICKEL		0.50	0.50	0.50	0.50	0.50	0.50
POTASSIUM		1.32	0.	1.02	2.83	1.86	2.22
SELENIUM	0.01	0.003	0.003	0.003	0.003	0.003	0.003
SILVER	0.05	0.0002	0.0003	0.0002	0.0002	0.0002	0.0002
SODIUM		14.41	9.94	15.39	15.55	13.90	22.00
STRONTIUM		0.2	0.2	0.2	0.2	0.2	0.2
THALLIUM		0.5	0.5	0.5	0.5	0.5	0.5
VANDAIUM		5	5	5	5	5	5
ZINC	5.0	0.05	0.05	0.05	0.05	0.05	0.05

In order to improve the quality of water delivered, the Hingham Water Company is planning to construct a new water treatment plant near the Free street wells. The treatment plant will provide oxidation, chemical mixing, flocculation, sedimentation, and filtering. This will solve the current problems with iron, manganese, and bacteria. The plant will treat water from Free St. wells Nos. 2, 3, and 4, Downing St. Well, and Accord Pond and Accord Brook. Water from the latter tw sources will be pumped from Fulling Mill Station to the treatment plant.

DISTRIBUTION AND STORAGE

The distribution system in Hingham is divided into two areas: the main service area and the high service area. The main service area is supplied by Accord Pond, Accord Brook, the Downing Street well, and Free St. wells Nos. 2,3, and 4. The high servic area is supplied by the Prospect St. well and the Scotland St. well.

The distribution system consists of 193 miles of water mains, 73 percent of which ar six-inch diameter or larger.

Storage is provided in one standpipe and two elevated tanks with a combined capacity of 3.25 million gallons. These facilities are:

Turkey Hill	2.00 mg
Strawberry Hill	0.50 mg
Accord	0.75 mg
Total Storage	3.25 mg

The total storage represents only one average day's demand. Because the storage facilities provide only short term storage equal to less than a peak day demand, the would be unable to compensate for lost water in the event of contamination of a supply source.

CHAPTER 3
WATER RESOURCES AND ENVIRONMENTALLY SENSITIVE AREAS

This chapter describes the characteristics of the natural environment within the town of Hingham and their significance to the potable water supplies. The areas covered are: watershed areas, topography, geology, groundwater resources, wetlands, and soils.

WATERSHED AREAS

The town of Hingham lies within the Weir River basin and portions of the Old Swamp River, Weymouth Back River, and Bound Brook watersheds. The study area for this report is the Weir River basin, which includes within its boundaries all of the Hingham Water Company's surface and groundwater sources (see figure 3-1). The reason for using the watershed area as the principal focus of the study is that it delineates the area within which land use and development activities may affect drinking water sources. Further, the delineation of watershed boundaries is based on topography which is straightforward and easily mapped.

The entire town will be surveyed for land use trends and potential contamination sources, with emphasis on the Weir River basin area, which contains the town's six public supply wells. Accord Pond and Accord Brook are used as surface water sources of supply and are also located within the Weir River basin.

The Weir River basin is about 9,675 acres, covering two-thirds of the town of Hingham. The river flows generally in a northerly direction through Hingham, draining into Hingham Bay. Small portions of the headwaters of the basin lie within the neighboring towns of Weymouth, Norwell, and Rockland.

TOPOGRAPHY AND GEOLOGY

Hingham's landscape was shaped by the glaciers which covered New England until about 10,000 years ago. The town can be divided into two topographic regions: the coastal zone to the north, and the inland hill and swamp area to the south. Most of the highest ground is inland, as the town generally slopes downward from south to north. About 75 percent of the land is less than 90 feet in elevation. The inland topography consists of low, generally rounded, hills and open valleys which have been modified by glaciation. The highest point is Prospect Hill, at 250 feet .

The bedrock geology of Hingham is composed of four parent material rock types. These include two types of granite--Salem gabbro diorite and the Dedham ganodiorite, the Mattapan volcanics, and the Roxbury conglomerate. The study area is underlain by the Dedham ganodiorite, which is a light gray coarsely crystalline granite formed by igneous processes about 375 million years ago. Throughout the town there are numerous bedrock outcrop, and in some areas only a thin veneer of surficial materials covers the bedrock.

The unconsolidated materials which overlie the bedrock consist of glacially derived till and stratified sand and gravel deposits. Postglacial deposits include swamp deposits, alluvium, and wind-blown sand and silt. The U.S.G.S. has mapped four distinct, surficial deposits in Hingham: till, silt and clay, fine to coarse gravel, and fine to coarse sand. Much of the glacially derived sand and gravel was deposited during the period of glacial melting in the form of kames, eskers, crevasse-fillings, and outwash plains. Much of the till was deposited by the action of the advancing glaciers in the form of drumlins and ground moraine. The drumlins form some of the higher topographic features in town.

GROUNDWATER RESOURCES

The occurrence of groundwater in the town is controlled by surficial and bedrock geology. Aquifers which yield sufficient quanitites of groundwater for public water supply are generally found in thick deposits of glacially deposited stratified sands and gravels, which are capable of storing and transmitting significant quantities of water. The thickest areas of such permeable deposits are generally found in "buried valleys," with depressions in the bedrock corresponding to former (pre-glacial) stream channels. According to the USGS Hydrologic Atlas, the most favorable aquifer areas, which are potentially capable of yielding more than 100 gallons per minute, underlie about 2850 acres of the study area. This sand and gravel aquifer has been mapped in greater detail by Weston Geophysical, Inc., based on test wells and seismic surveys (see figure 3-1). All of Hingham's six public supply wells are located within this aquifer area, which comprises about 20 percent of the town's area.

The U.S.G.S. has also mapped the estimated saturated thickness of the aquifer (see figure 3-2). This map conforms to the Weston Geophysical aquifer map in that the areas mapped as greater than 20 feet of saturated thickness correspond well with the boundaries of the sand and gravel aquifer.

The 2,850 acre aquifer area is the most significant and sensitive part of town with regards to the quality of Hingham's drinking water. Any sources of pollution or contamination within this area may potentially affect the town's water supplies. This area should receive special attention in any groundwater protection measures.

SOILS

There are five major soil associations in Hingham (see Figure 3-3). A brief description of each follows:

(1) Hollis-Charlton-Brockton soils are excessively drained to poorly drained, occurring on moderate to steep slopes and low-lying areas. These soils are stony with bedrock outcrops; bedrock is usually less than three feet below the surface.

(2) Quonset-Warwick-Hinckley soils are sandy and excessively drained. These soils overlie much of the sand and gravel aquifer area.

(3) Bernardston-scituate-Pittstown soils are moderately to well drained soils occurring on level to moderate slopes. A less permeable hardpan is found at a depth of about two feet. These soils experience high water tables in the winter and early spring.

(4) Gloucester soils are stoney and somewhat excessively drained. A hardpan is often present at about 2.5 feet.

(5) Muck-Peat soils are very poorly drained mineral and organic soils. The water table is at or near the surface most of the year.

WETLANDS

Wetlands are low-lying, transitional areas between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetland areas have several unique functions and values with respect to water supplies: they filter pollutants entering streams, provide temporary storage for flood control, supply base flows for streams and rivers, and supply water to the surface system in periods of limited rainfall. In Massachusetts wetlands are delineated by the presence of wetlands vegetations under the state Wetlands Protection Act.

According to the MacConnell land use maps about 474 acres or 3 percent of the town of Hingham is in wetlands.

PRECIPITATION

Precipitation averages approximately 44 inches annually. Between 20 and 24 inches of precipitation per year is carried as runoff, with the remainder cycled through evaporation, transpiration or recharge into groundwater. (See Appendix C for overview of hydrologic principles.)

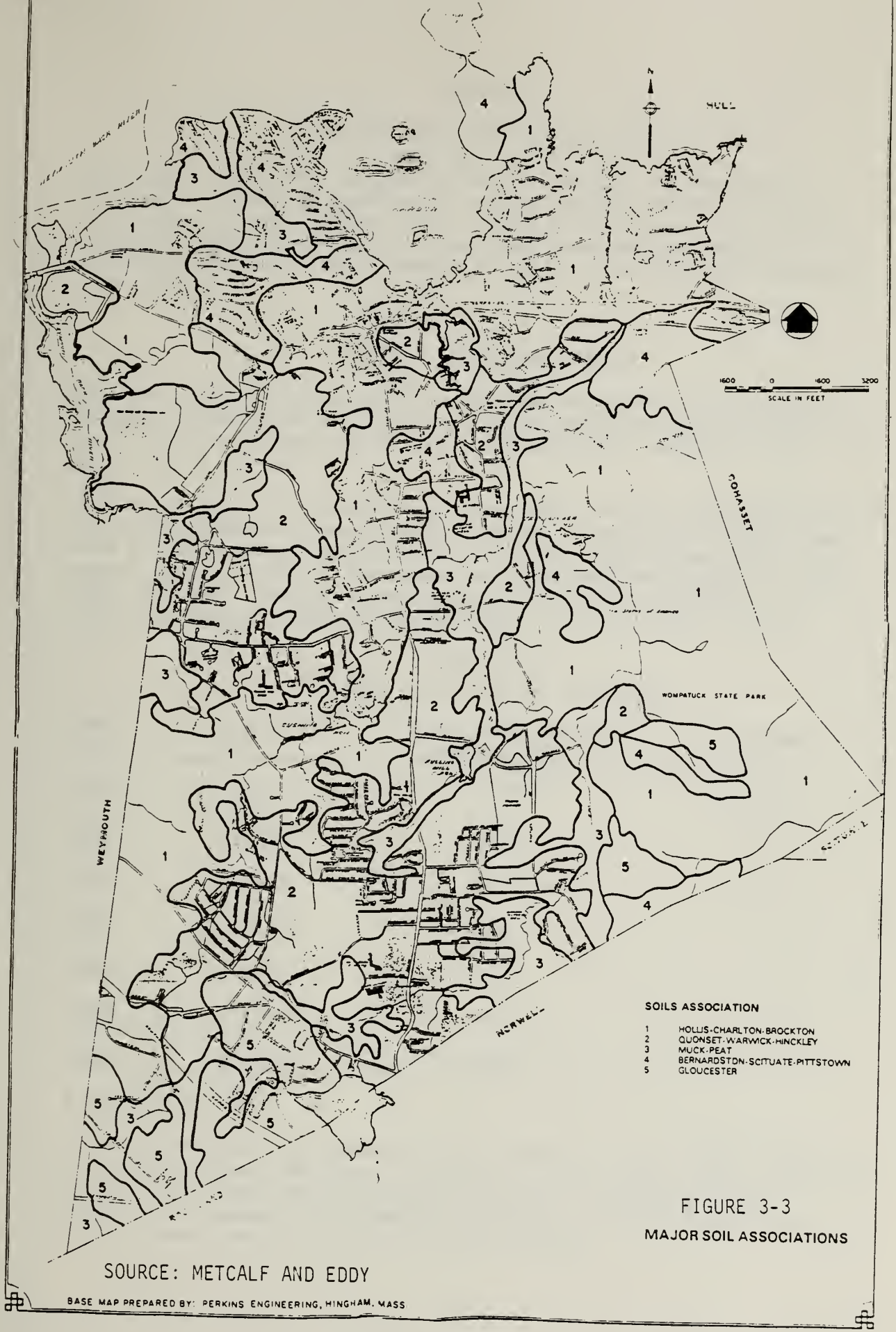


FIGURE 3-3

MAJOR SOIL ASSOCIATIONS

SOURCE: METCALF AND EDDY

BASE MAP PREPARED BY: PERKINS ENGINEERING, HINGHAM, MASS.

CHAPTER 4

LAND USE AND WATER SUPPLY IMPACTS

This chapter describes the uses of land in the town of Hingham, and examines the potential impacts of land use on the quality and quantity of water supply sources in the town. After a brief review of the recent growth and development trends of the town, water supply impacts will be addressed in terms of the potential sources of contamination associated with land use.

HISTORIC DEVELOPMENT TRENDS

This section reviews the last three decades of growth and development in Hingham. This perspective aids in understanding the existing land uses, as it provides information on past activities which today may affect the water supply sources.

The data on historic land use was taken from a study by William MacConnell at the University of Massachusetts, who has classified and mapped land uses by interpretation of aerial photography. The minimum parcel size mapped was three acres. MacConnell analyzed land use changes in 1951, 1971, and 1980. Table 4-1 summarizes the population and population density of Hingham between 1950 and 1980.

Table 4-1
HISTORIC AND PROJECTED POPULATION

Year	Population	Population Density (person/sq. mi.)	% Change
1950	10,665	471	-
1960	15,378	679	44
1970	18,845	832	22
1980	20,339	898	8
1990*	22,100	976	9
2000*	22,500	993	2
2010*	22,600	1,000	1

* MAPC Projections

The data shows that the population has doubled in thirty years. However, the population has stabilized in the most recent decade, with almost all of the growth occurring between 1950 and 1970. According to MAPC projections, Hingham will experience moderate population growth over the next 25 years, reaching 22,600 by the year 2010.

The historic population growth in Hingham is reflected in the changing land uses in the town over the last 30years. Table 4-2 shows the breakdown of land uses for 1951 and 1980. Of note is that "developed" land uses more than doubled from 2,701 to 5,480 acres. The largest gain in acres was residential, which increased 1,737 acres. The 273 percent growth of commercial land was the largest percentage growth. "Undeveloped" land uses dropped 2,779 acres, or 24 percent. The largest loss was agricultural which dropped by 1,283 acres, or 72 percent.

Table 4-2
HINGHAM LAND USE CHANGE, 1951-1980[1]

Land Use	1951 (acres)	1980 (acres)	Change (acres)	Percent Change
Residential	2,079	3,816	+1,737	+84
Industrial	156	277	+121	+78
Commercial	52	194	+142	+273
Open & Public	378	682	+304	+80
Transportation	36	89	53	+147
Mining[2]	—	178	—	—
Outdoor Recreation[2]	—	244	—	—
Total Developed Land	2,701	5,480	+2,779	+103
Forest	8,279	7,595	-684	-8
Wetlands	813	474	-339	-42
Open	898	139	-759	-85
Agriculture	1,782	499	-1,283	-72
Water	28	314	+286	+1021
Toal Undeveloped Land	11,800	9,021	-2,779	-24
TOTAL	14,501	14,501	—	—

[1]Source: MacConnell, University of Massachusetts
[2]Mining and Outdoor Recreation were not included in the 1951 survey.

Figure 4-2

HINGHAM LAND USE CHANGE, 1951-1980

SUMMARY OF EXISTING LAND USE

The current land use in the town has been classified for analysis and mapped in Figure 4-1. Table 4-3 shows the acreage of each land use category in 1980. Hingham is about 38 percent in "developed" land uses,of which 26 percent is residential. Industrial and commercial represent less than 2 percent each. About 62 percent of the town is undeveloped, of which 52 percent is forested. Agriculture and wetlands represent about 3 percent each.

Table 4-3
HINGHAM LAND USE, 1980

Land Use	Acres	Percent
Residential	3,816	26.3
Industrial	277	1.9
Commercial	194	1.3
Open & Public	682	4.7
Transportation	89	0.6
Mining	178	1.2
Outdoor Recreation	244	1.7
Developed Land	5,480	37.7
Forest	7,595	52.4
Wetlands	474	3.3
Open	139	1.0
Agriculture	499	3.4
Water	314	2.2
Undeveloped Land	9,021	62.3
TOTAL	14,501	100

The aquifer which supplies the town's wells covers about 2,850 acres,or 20 percent of the town. Within the aquifer area, a greater percentage of the land is developed, as shown in Table 4-4. About 42 percent of the aquifer area is developed, with 35 percent in residential land. Undeveloped land represents 58 percent of the aquifer area, with forested land comprising the largest share, 35 percent.

Table 4-4
Hingham Water Supply Aquifer
Land Use, 1980

Land Use	Acres	Percent
Residential	998	35
Commercial	10	.3
Open & Public	114	4
Mining	32	1.2
Outdoor Recreation	50	1.8
Developed Land	1,204	42.3
Forest	1,010	35
Agriculture	136	4.8
Water	68	2.5
Wetlands	95	3.4
Public Land	339	12.0
Undeveloped Land	1,648	57.7
Total	2,852	100.0

Within the aquifer area, about 477 acres is open space owned by the town or the Hingham Water Company for the protection of the well.

LAND USE/WATER SUPPLY IMPACTS

Land uses within the water supply watershed can affect both water quality and water quantity through physical alteration of the environment which changes drainage patterns and rates of runoff and recharge, and through discharge of contaminants to surface or groundwater. In this chapter, the potential impacts of land uses on water supplies are analyzed in terms of the physical alterations and chemical contaminants associated with each. For each of these potential sources of contamination, the analysis

presents:

- o the characteristics and water supply impacts;
- o the land uses associated with each; and
- o existing conditions in Hingham describing the prevalence of these land uses within the water supply watershed.

The potential sources of contamination addressed are: underground fuel storage tanks, wastewater, road salt, leachate, hazardous wastes, pesticides, mineral extraction.

As can be seen in table 4-3 approximately 62 percent of the town is undeveloped. This land has potential for future development. Such primarily undeveloped property provides a natural recharge area for groundwater and surface water and this has no adverse effect on either the quantity or quality of drinking water supplies. The developed land uses in the watershed have the potential to cause impacts on the quantity and quality of water supply in Hingham. The relationship between land uses and potential drinking water impacts is summarized in figure 4-4 and described in the following section.

Figure 4-3

Hingham Aquifer Area
Land Use Breakdown, 1980

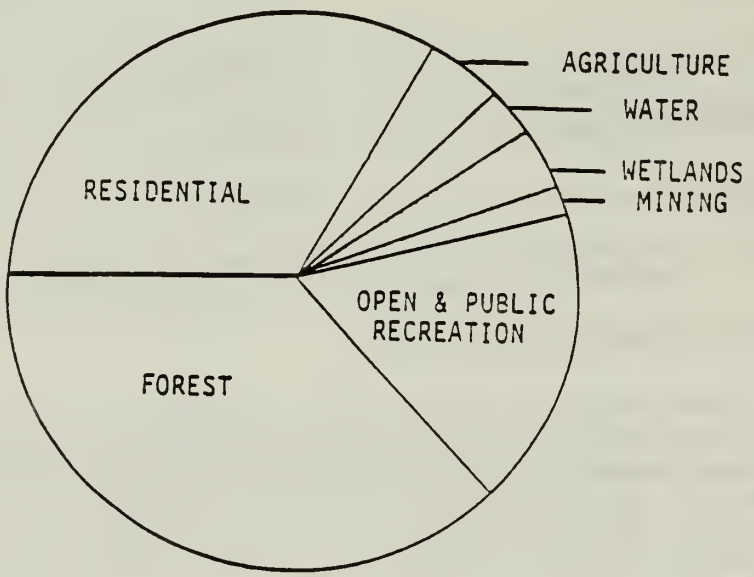
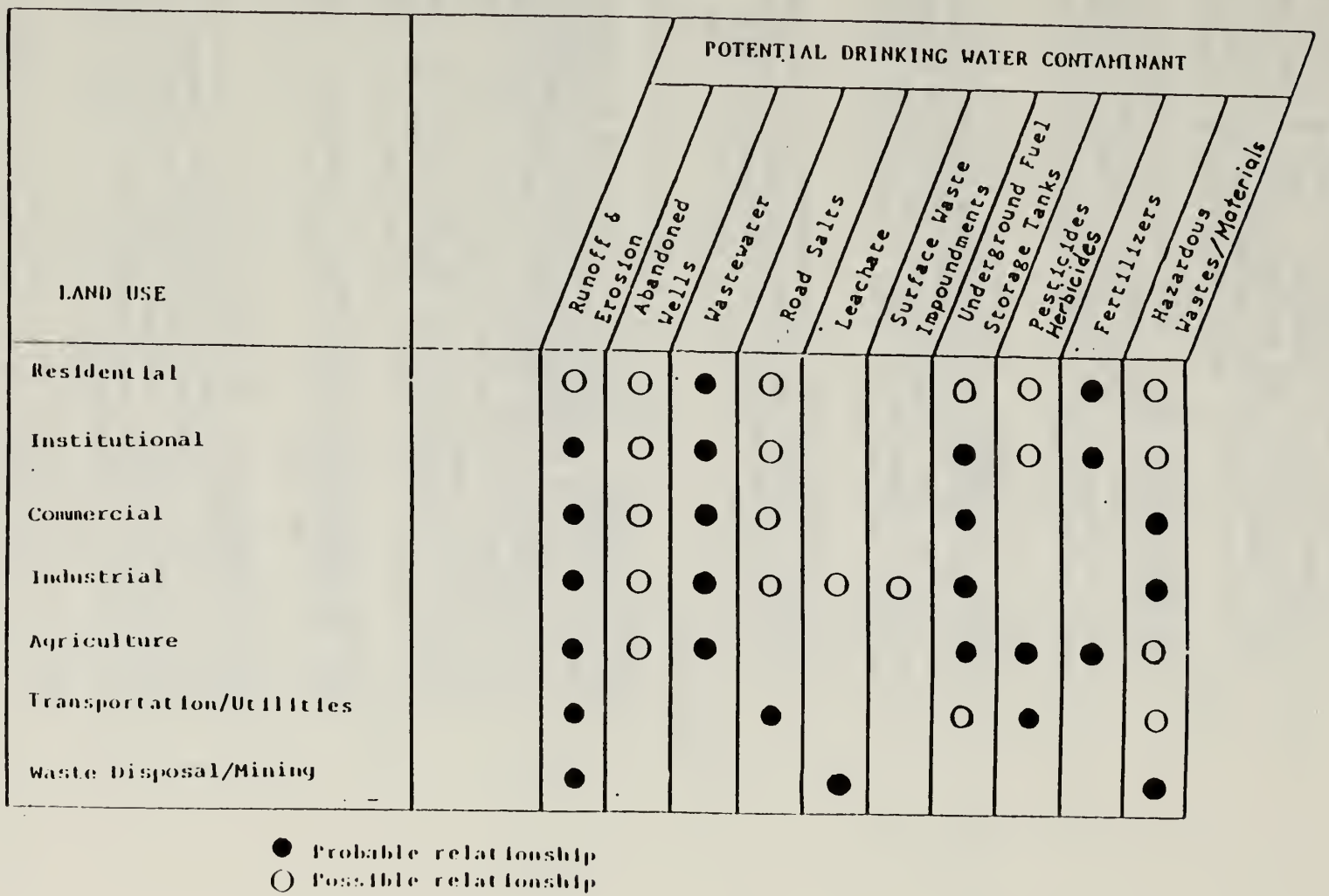


Figure 4-4

EFFECTS OF LAND USES ON WATER SUPPLY SOURCES



POTENTIAL SOURCES OF CONTAMINATION

1. Underground Fuel Storage

   a. Potential Impacts. Leakage of tanks or piping which are subject to corrosion or puncturing. Unprotected steel tanks have an average life expectency of 15 years in corrosive soils. Most soil types in Massachusetts are corrosive. Once it leaks, gasoline can move through the ground and contaminate public or private wells. A small amount of fuel can contaminate much water, since concentrations of more than several parts per billion are considered unsafe.

   b. Land Use Associations. Fuel storage is typically associated with service stations, fuel companies, auto dealerships, public works facilities, bus and truck fleets, schools, churches and other institutions, and a residences where large underground tanks are installed for additional storage.

   c. Existing Conditions. There are at least 50 facilities with gasoline storage in Hingham, 29 of which are within the water supply watershed. Nearly half of these are probably more than 15 years old. Within the aquifer area, there are at least 138 heating oil storage tanks. About 60 of these are at least 15 years old. Several are in close proximity to town wells.

      There has been at least one documented case of underground fuel leakage in Hingham, near Queen Anne Lane. The Fire Department now requires the installation of observation wells at new installations. These have been installed at 12 facilities in town.

2. Wastewater

   a. Potential impact. Both surface water and groundwater supplies can be affected by problems associated with disposal of sanitary wastes. Failing septic systems can be caused by improper siting, installation or maintenance. Soil type, depth to bedrock and depth to the water table can be major facotrs in septic systems failures. Such failures can introduce excessive nutrients, chlorides, bacteria and household chemicals into soil which can then leach into water supplies. According to DEQE, septic systems on lots less than 40,000 square feet in area have the potential to contaminate groundwater.

   b. Land Use Associations. Residential, commercial, and industrial, land use generate wastewater. These land uses occupy about 30 percent of the town.

   c. Existing Conditions. The entire watershed area is unsewered, thus relying on septic systems to treat sanitary wastes. The northwestern corner of town is sewered, and wastes are pumped to the MWRA treatment plant at Nut Island. This sewer service area does not extend into the watershed. Areas being considered for sewer system expansion are also out of the watershed.

      There is only one NPDES discharge permit in Hingham, and it is not in the watershed.

TABLE 4-5

SUMMARY OF UNDERGROUND FUEL (AQUIFER AREA) -- FUEL OIL

Age of Permit (Years)	SIZE OF TANK (GALLONS)					
	less than 500	500-1000	> 1000-2000	more than 2000	Unknown	Total
0-5	6	9	1			16
5-10	17	13	3	4	2	39
10-15	13	5	0	1		19
15-20	6	4	3	0		13
> 20	15	13	10	8		46
Unknown	2	2	1			5
TOTAL	59	46	18	13	2	138

TABLE 4-6

SUMMARY OF UNDERGROUND FUEL (TOWN-WIDE) -- GASOLINE

AGE OF PERMIT	QUANTITY OF FUEL (GALLONS)				
	S 1000	> 1000-6000	> 6000-12,000	> 12,000	TOTAL
0-5				1	1
5-10	3	1	0	0	4
10-15	7	1	3	3	14
15-20	3	2	1	1	7
> 20	4	4	6	2	16
Unknown	2	0	2	4	8
TOTAL	19	8	12	11	50

TABLE 4-7
UNDERGROUND FUEL STORAGE LICENSES

Name & Address	Permit Date	Gas	Fuel Oil	Misc.
110 Charles	1963	1,500	25,000	
Catholic Foreign Mission Society	1976	2,500	25,000	
308 Cushing	1969	2,000		
Hingham Light Dept.	1974	10,000		
87 Derby	1960	16,000		1,000
SUNOCO	1985	8,000	1,000	
100 Derby	1962	36,000		
Gas Country				
128 Derby	1964	2,000		
Best Chevrolet				
211 Downer	1964	2,000		
Hing. Y.C.				
15 Fort Hill	1932	1,000		
19 Fort Hill	1973	30,000		
43 Fresh River Rd.	1974	4,000		
C. Spirito, Inc.				
90 Industrial Park	1976		15,000	
GMS Realty Trust				
90 Industrial Park	1974	5,000		
JRS Realty Trust	1975	2-5,000		
100 Industrial Park	1965		15,000	
Merriman				
120 Industrial Park	1973	10,000		
New Eng. Sealcoating				
100 Kilby				
Joseph Calvi	1974	3,000		
156 Kilby	1947	10,000		
Rocco V. Amonte				
169 Lincoln	1974	10,000		
Police				
179 Lincoln	1961	15,000		500 waste
AJ Exxon				

TABLE 4-7 (Continued)

Name & Address	Permit Date	Gas	Fuel Oil	Misc.
193 Lincoln Geo. Morse	1957		6,200	
223 Lincoln Walter Secatore, Jr.	1962	15,000		
315 Lincoln Hingham Dodge	1964	1,000		
339 Lincoln ?	1972 ?		60,000	
339 Lincoln Allied Industries	?	15,000		
349 Lincoln Hewitt's Cove Marina	1964	4,000		
349 Lincoln Yankee Oxygen	1971			
400 Lincoln Curtlo Realty Trust	1971			1,000 Class A & B Flamable
421 Lincoln Landfill Auto Service	1947 1970	10,000 24,000		
427 (425?) Lincoln Shaw, Inc. (H&A White)	1955	10,000		
433 Lincoln	1958	10,000		
274 Main Chas. H. Cushing, Inc.	1934 1972	2,000 12,000		
339 Main Fire Dept.	1976	7,000 diesel		
1073 Main Notre Dame	1964		10,000	
1105 Main School Dept.	1961		15,000	
161 New Bridge K. Brewer	1946	1,000		

TABLE 4-7 (CONTINUED)

Name & Address	Permit Date	Gas	Fuel Oil	Misc.
13-15 North Wm. F. Quinn, Inc.	1949 1960	10,000 14,000		
36 North Wm. F. Quinn	1929			
Lot 19 Pine Anthony Barbuto	1962	3,000		
41 Pleasant School Dept.	1953		10,480	
75 Recreation Rd. Pilgrim Skating Arena	1973	1,000		
100 Research Rd. Tronlox Trust	1968	2,000		8,000 Industrial Cutting Oil
105 Research Rd. Paperama Devel. Trust	1980	5,000		
168-170 Rockland Rd. Royal Gas	1939	10,000		
345 Rockland Rd.	1972	11,000		
8 Short St. Hing. Tree & Park Dept.	1971	1,000		
9 Short St. Shell Oil	1934 1950 1973 1985	 6,000 3,000		
274 South St. S.S Country Club				
93 South Pleasant H. Water Co.				
6 Station St. (50 North) Station North R.T.	1954	10,000		

TABLE 4-7 (CONTINUED)

Name & Address	Permit Date	Gas	Fuel Oil	Misc.
2-8 Summer St.				
Tom O'Brian Chrysler/Plym.	1945	10,000		
9 Summer				
M. & G. Krall	1962			
Removed				
16 Summer	1969		20,000 Total	
Mobil Oil	1984	8,000		
19 Summer				
Hingham Car Wash	1967	16,000 - gas		
	1977	4,000 - diesel		
		15,000 - gas		
25 Summer	1965	15,000		
Shell Oil	1970	20,000		
26 Summer				
Vernon Conlin		10,000		
29 & 31 Summer	1936	9,000		
Gulf (Chevron)	1981	39,000		
97 Ward	1953	1,000		
E. Margetts				
4 Whiting				
Getty	1949	10,000		
19-21 Whiting	1956	10,000		
Gulf Oil	1975	20,000		
193 Whiting	1962	14,000		
Mortgage Shops, Inc.	1975	6,000		
(Amoco)				
194 Whiting	1930	2,000		
Mutual Oil	1959	10,000		
	1974	8,000		
	1975	10,000		
270 Whiting	1954	8,000		
Wm. Costa				
410 Whiting				
Plymouth Quarries	1933	500		
	1973	10,000		

Table 4-8
UNDERGROUND FUEL STORAGE PERMITS (HEATING OIL)
IN AQUIFER PROTECTION DISTRICT

Street Location	Applicant	Tank Size	Date of License
25 Charles St.	S. Baker	500 Gallons	1985
206 " "	M & R Realty Trust	300 "	1975
6 Crooked Meadow Lane	Volunteer Realty Tr.	275 "	1972
8 " "	" " "	275	1972
394 Cushing Street	R. Murley	1000 "	1979
398 " "	Colonial Const.	300 "	1979
402 " "	" "	1000	1980
424 " "	G. Darmon	1000 "	?
444 " "	"	500	1979
21 Fairview	A.C. Linscott	500 "	1957
31 "	R.W. Baynes	2000 "	1977
119 Free Street	Paul Johnson	1000 "	1980
135 " "	W. Knight	1000 "	1973
5 Fulling Mill Road	Paul Johnson	1000 "	1983
7 " " "	R.D. Matthews	1000 "	1983
10 " " "	R. Driscoll, Jr.	2000 "	1985
15 " " "	Robert Stitt	1000 "	1983
247 Gardner St.	Hardiman	275 "	1975
304 Gardner St.	Diersch	275 "	?
Liberty Rd., Lot 14	Ocean Realty Trust	1000 "	1977
" ", Lot 1A	Lincoln	1000 "	1973
12 Liberty Rd.	Leary	300 "	1978
14 " "	"	300 "	1978
15 " "	"	300 "	1976
16 " "	"	300 "	1977
19 " "	Robert Dattman	1000 "	1983
280 Main Street	Commercial Realty	6000 "	1964
339 " "	Hingham Fire Dept.	1000 "	1966
342 " "	GAR Hall	500 "	1984
378 " "	Hingham Cong. Church	1000 "	1947
392 " "	Achille Greenhouses	2000 "	1950
402 " "	Heibert Burns	1000 "	1963
409 " "	Roger Earle	1000 "	1973
423 " "	G.H. Lundergreen	275 "	1945
424 " "	W. Benjamin	275 "	1962
446 " "	J. Pompeo	500 "	1955
486 " "	R. Bouve	110 "	1941

Table 4-8 Continued

Street Location	Applicant	Tank Size	Date of License
515 Main Street	Dr. S. Garland	1000 Gallons	1985
570 " "	M. Shattuck	500 "	1971
584 " "	So. Shore Baptist	1000 "	1956
597 " "	E. Gelsthorpe	225 "	1973
597 (rear) "	H. Hess	275 "	1985
613 " "	J.E. Threlfall	110 "	1945
650 " "	J.H. Kimball	55 "	1948
657 " "	J.B. Howland	1000 "	1947
721 " "	R.G. Oates	1000 "	1975
730 " "	C.W. Hobart	1000 "	1946
754 " "	B. Minnervitz	1000 "	1980
754 " "	W. Butterworth	1000 "	1959
764 " "	G. Emerson	1000 "	1961
774 " "	Rand Development	300 "	1984
831 " "	South Elementary	2-5000 "	1979
962 " "	W.I. Nichols	1000 "	1947
971 " "	R.H. Hull	500 "	1954
1057 " "	Resurrection Rectory	1000 "	1966
1057 " "	" Parish	1000 "	1958
1073 " "	Notre Dame Academy	10,000 "	1965
1082 " "	W. Potter	1000 "	1978
1105 " "	South Junior High	15,000 "	1962
1111 " "	J. Marchesiani	2000 "	1975
1126 " "	T. Marchesiani	500 "	1981
170 Prospect Street	Mark Engel	1000 "	1978
179 " "	Whiting	500 "	1975
220 " "	Thompson	275 "	1950
222 " "	Latady	275 "	1973
8 Pine Grove Road	Aiello	300 "	1968
10 " "	Aiello	500 "	?
24 Scotland Street	Matarazo	500 "	1954
34 " "	Mancini	500 "	1952
80 " "	Sunergren	275 "	1977
84 " "	Ettinger	275 "	1980
88 " "	Braintree Homes	275 "	1957
92 " "	" "	275 "	1957
107 " "	Di Tocco	350 "	1981
96 " "	Braintree Homes	275 "	1957
108 " "	" "	275 "	1957
112 " "	" "	275 "	1957
118? " "	" "	275 "	1957
7 Pleasant Street	Santoro	2000 "	1978
35 " "	Cruikshank	500 "	1970
87 " "	Carter Hill	275 "	1979
41 " "	Hingham High School	10,480 "	1953
115 Prospect Street	Delmonico	1000 "	1973
135 " "	Peterson	500 "	1976
149 " "	Cavallo	500 "	1982

Table 4-8 Continued

Street Location	Applicant	Tank Size	Date of License
3 Richard Road		275 Gallons	1958
5 Richard Road		275 "	1958
Studley Road, Lot 2	M & M Construction	?	1950
5 Studley Road	Ginger Delong	275 "	1969
12 " "	Elmer Crooker	275 "	1970
72 South Pleasant St.	Lehner	1000 "	1977
72 " " "	"	1000 "	1983
93 " " "	Hingham Water Co.	500	1956

A 1983 Wastewater Management Study conducted by Metcalf and Eddy found numerous cases of septic system failures and frequent pump-outs. Many of these are within the aquifer area, and are shown on Figure 4-5.

The major concern for the town's water supply is the proper installation, operation, and maintenance of septic systems.

3. Road Salt

a. Potential impacts. Deicing chemicals such as sodium chloride applied to roads in winter or stored in uncovered piles can wash off pavements into surface water bodies or percolate through soils to groundwaters. Since standard water treatment systems are unable to remove sodium from drinking water, sodium concentrations which may be harmful to the health of some individuals may result. Also, at high concentrations, sodium can corrode water distribution pipes and water fixtures. Therefore, the Massachusetts Department of Environmental Quality Engineering has set a health standard of 20 mg/l for sodium. DEQE requires regular sampling and analysis of sodium concentrations in public water supplies and notification of customers if the concentrations exceed the standard.

b. Land Use Associations. Land uses which are associated with use of road salts are transportation, for maintaining road safety in the winter, and residential, institutional, commercial and industrial, for clearing parking lots and private drives.

c. Existing Conditions. Road salt used by the town of Hingham is stored out of the watersheds. The town maintains all streets except state routes in Hingham. A sand and salt mixture with a 5:1 mixture is used on most streets. Primary roadways may receive up to a 3:1 mixture during heavy storms. This includes Main Street, Hobart St. and High St. within the watershed. The town uses a total of about 800 tons of salt in an average year.

The State DPW maintains Routes 3, 3A, 53, and Derby Street, as well as several other routes out of the watershed. The state applies 100 percent salt to all routes, at a rate of 300 pounds per lane mile. There are about 5 miles of roadways maintained by the state in the watershed. However, these are at the periphery of the watershed, at least 1.3 miles from the nearest town wells.

4. Leachate

a. Potential Imapcts. Leachate is liquid waste which results when water percolates through buried materials in sanitary landfills waste impoundments, and other disposal sites. Depending on the characteristics of the buried materials, leachate can contain inorganic and organic contaminants, as well as dissolved solids which can degrade groundwater supplies.

b. Land Use Associations. Land uses which may be associated with leachate generation are classified as waste, industrial and commercial. Waste uses include sanitary landfills and other official dump sites.

c. Existing Conditions. Hingham operates a sanitary landfill which is located just beyond the boundary of the watershed. Some localized groundwater contamination has been detected, such as heavy metals and volitile organics. Water quality monitoring is being conducted, with quarterly water sampling from 15 observation wells and surface water runoff from the site.

The landfill has an expected useful life of about 15 years. It currently handles about 12,500 tons per year, of which 10,000 tons is residential waste and 2500 is commercial and industrial.

Another potential source of leachate in Hingham is a waste impoundment off of Ward Street, at the Merriman Division of Litton Industries. This is out of the watershed, but it is within the watershed of Weymouth's water supply. The facility is listed by SIC code as a manufacturer of mechanical power transmission equipment for industrial machinery. According to the Massachusetts DEQE the waste lagoons contain no hazardous wastes.

5. Hazardous Wastes

a. Potential Impacts. Hazardous wastes are wastes which are toxic, reactive, corrosive or ignitable. Improper handling of hazardous wastes is an obvious threat to drinking waters; however, federal and state regulations have been enacted to reduce the threat of contamination, including water supply contamination. A less obvious source of hazardous wastes is what is commonly referred to as "household hazardous wastes". These include materials such as bleach, mothballs, paint remover, oven cleaner, wood preservative, and used motor oil. Improperly disposed of, they also can reach groundwater or surface water and result in contamination of supplies. This is especially true in an unsewered area, such as Hingham's water supply watershed. All materials disposed of "down the drain" will reach the groundwater through on-lot septic systems, which are not designed to treat many chemical wastes.

b. Land Use Associations. All developed land use types have the potential to be associated with hazardous wastes. Thirty percent of the town is developed with residential, industrial, and commercial land uses. In addition, transportation corridors are susceptible to accidental spills.

c. Existing Conditions. There are no known jazardous waste sources within the watershed according to DEQE data. The only industrial land in the watershed is in the Route 3/Route 53 corridor at least 2 miles from the nearest well, and out of the aquifer area.

There is significant residential development near most of the wells, raising the possibility of problems with household hazardous waste. The town has had a voluntary collection of household hazardous wastes. There is however, no evidence that hazardous wastes from any source has affected the town's water supply. Nevettheless, residents should be aware that any wastes flushed "down the drain" will end up in the groundwater.

6. Pesticides

a. Potential Impacts. The term pesticides includes insecticides, herbicides and rodenticides. These are all chemical compounds used to control unwanted organisms such as insects, weeds and rodents. Since the compounds vary depending upon their target organisms, their potential water resources effects also vary greatly. Pesticides may enter water supplies by direct infiltration through the ground or by way of runoff. Water supply impacts may be caused by improper use storage, or disposal of pesticide products. In some locations, even properly regulated applicaiton may have the potential to imapct water supplies.

b. Land Use Associations. Land uses associated with use of pesticides are residential, institutional, transportation, utility (electrical), and agricultural and recreation. Homeowners use pesticides to control insects, weeds and rodents in gardens and homes. Municipal departments of public works often use herbicides for part or road maintenance. Golf courses often use herbicides and fungicides to maintain the turf.

Utility companies use selective pesticide applications to eliminate tall-growing trees which interfere with the function of the utility lines. The general amount herbicide used for this is less than one gallon per acre.

The intent of railroad herbicide applications is to control all vegetation along the track since it may cause instability or lead to fires. The area usually treated is about 12 ffet to either side of the center of the track, known as the railroad layout or ballast area. A number of chemicals are used together which generally amount to 5 to 8 gallons of herbicide per acre.

Organic pesticides may be used directly in lakes and reservoirs for control of aquatic insects. Other methods of their reaching water bodies are accidental drift from agricultural applications, and discharge of rinse water from equipment cleanup after application.

c. Existing Conditions. Potential sources of pesticides in the watershed include the residential land near the wells, the agricultural land near all the Free Street wells, and the playing fields near the Downing Street well. There is no evidence that pesticides associated with any of these land uses is currently impacting the water supply.

7. Mining

a. Characteristics and Water Supply Impacts. Mining poses a threat to groundwater if the excavation reaches too close to the water table, not leaving a sufficient buffer zone for contaminants to be filtered out. Future land uses on abandoned mines should also be carefully regulated, considering the potential groundwater impacts.

b. Land Use Associations. Mining; sand and gravel excavation.

c. Existing Conditions. There are several extractive land uses located in the southwestern periphery of the watershed. None of these are within the aquifer area. The closest of these is nearly two miles from the nearest well.

TABLE 4-9

HINGHAM HAZARDOUS WASTE HANDLERS

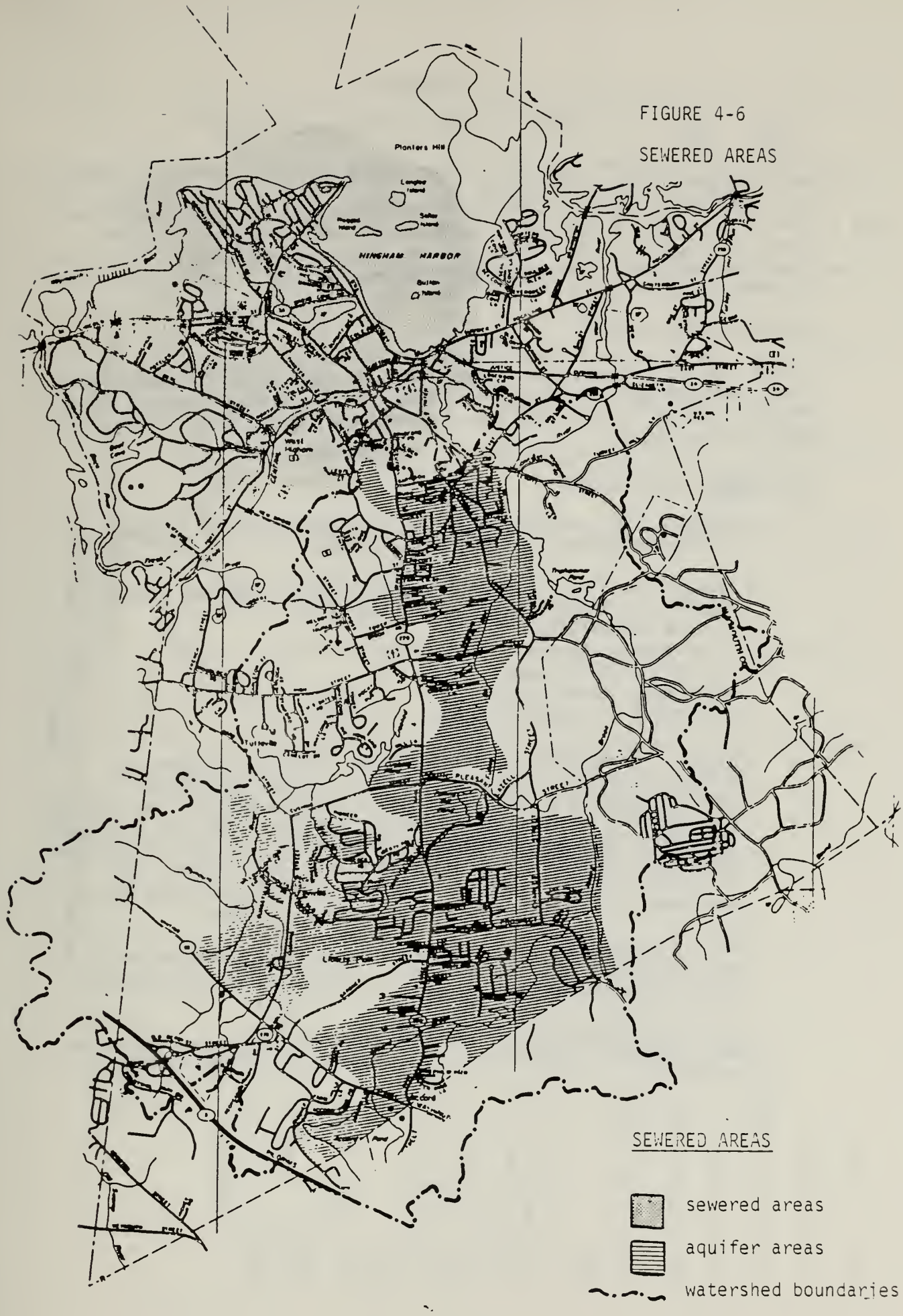
Facility	Address	Activity Type [1]	Regulatory Status [2]
Best Chevrolet	128 Derby St.	G	2
Building 19 Inc.	349 Lincoln St.	G	
Eastern Medical Plastics	27 Fottler Rd.		1
Eastern Process Co.	2 Churchill Rd.	G	
High Vacuum Equip.	110 Indust. Park Rd.	G	2
Hingham Mun. Light	308 Cushing St.	G	
MacKenzie Machine	25 Mill Lane	G	2
Markings, Inc.	85 Research Rd.	G	2
Massa Products	280 Lincoln St.	G	
Merriman (Div. Quanco)	100 Indust. Park Rd.	G,S	4
Meterex Corp.	25 Indust. Park Rd.	G	2
N.E. Book Components	125 Indust. Park Rd.	G	
N.E. Sciences, Inc.	55 Indust. Park Rd.	G	2
Pyrotector, Inc.	333 Lincoln St.	G	
Quality Fiberglass	26 Summer St.		1
Russelectric, Inc.	S.S. Indust. Park	G	
Semi Conductor Processing	10 Indust. Park Rd.	G	
Spencer Press	90 Indust. Park Rd.		1
Thomas Auto Body	15 Fort Hill St.	G	2
IRW, Inc	10 Keith Way		1
Twin City Laundry	193 Lincoln St.	G	2
U.S. Repeating Arms	100 Research Rd.	G	
U.S. G.S.A. Supply Dist.	295 Lincoln St.	G	
Vulcan Co.	51 Sharp St.	G	

[1] Activity Type: G = Generator; S = Storage

[2] Regulatory Status: 1 = Non regulated (Non-handler)
2 = Non regulated (Small quantity)
4 = RCRA Part A Withdrawal Candidate

FIGURE 4-6

SEWERED AREAS



Chapter 5

ZONING AND REGULATION OF LAND USE

The preceding chapter focused on land uses which have potential impacts on water supplies. In this chapter existing local, state, and federal laws and regulations which control those land uses will be summarized. The town's zoning bylaw will also be examined in order to determine the potential impacts of future development, and its compatibility with water supply protection. This regulatory analysis will form the basis of the recommendations made in the next chapter.

EXISTING REGULATIONS

A host of local, state, and federal laws and regulations currently exist which regulate the land uses identified above as having potential water quality impacts. These laws and regulations are summarized in Figure 5-1 and described below.

Underground Fuel Storage

- Federal. EPA is developing new requirements which will set minimum standards for state regulations.

- State. The Board of Fire Prevention Regulations has issued new regulations which require: (527 CMR 9.00)
  - tank registration
  - inventory control
  - non-corrosive tanks
  - periodic tank testing
  - removal of abandoned tanks

- Local. The Board of Selectmen issues licenses for gasoline storage over 165 gallons and fuel oil storage over 10,000 gallons. The Fire Department issues permits for fuel oil storage less than 10,000 gallons. The Fire Department also has a program to identify and remove abandoned fuel tanks. In 1984, twenty-two tanks were removed at five locations in town. In 1985, the Selectmen voted to revoke an additional 15 licenses, and the Fire Department is following up on removing those tanks.

- The Fire Department has also been requiring observation wells at new underground tank installations. About 12 new installations have been completed with observation wells.

- Within the Accord Pond Watershed Protection District, underground fuel tanks are regulated by the zoning bylaw. (See section on zoning.)

Figure 5-1
Potential Impacts and Management Techniques

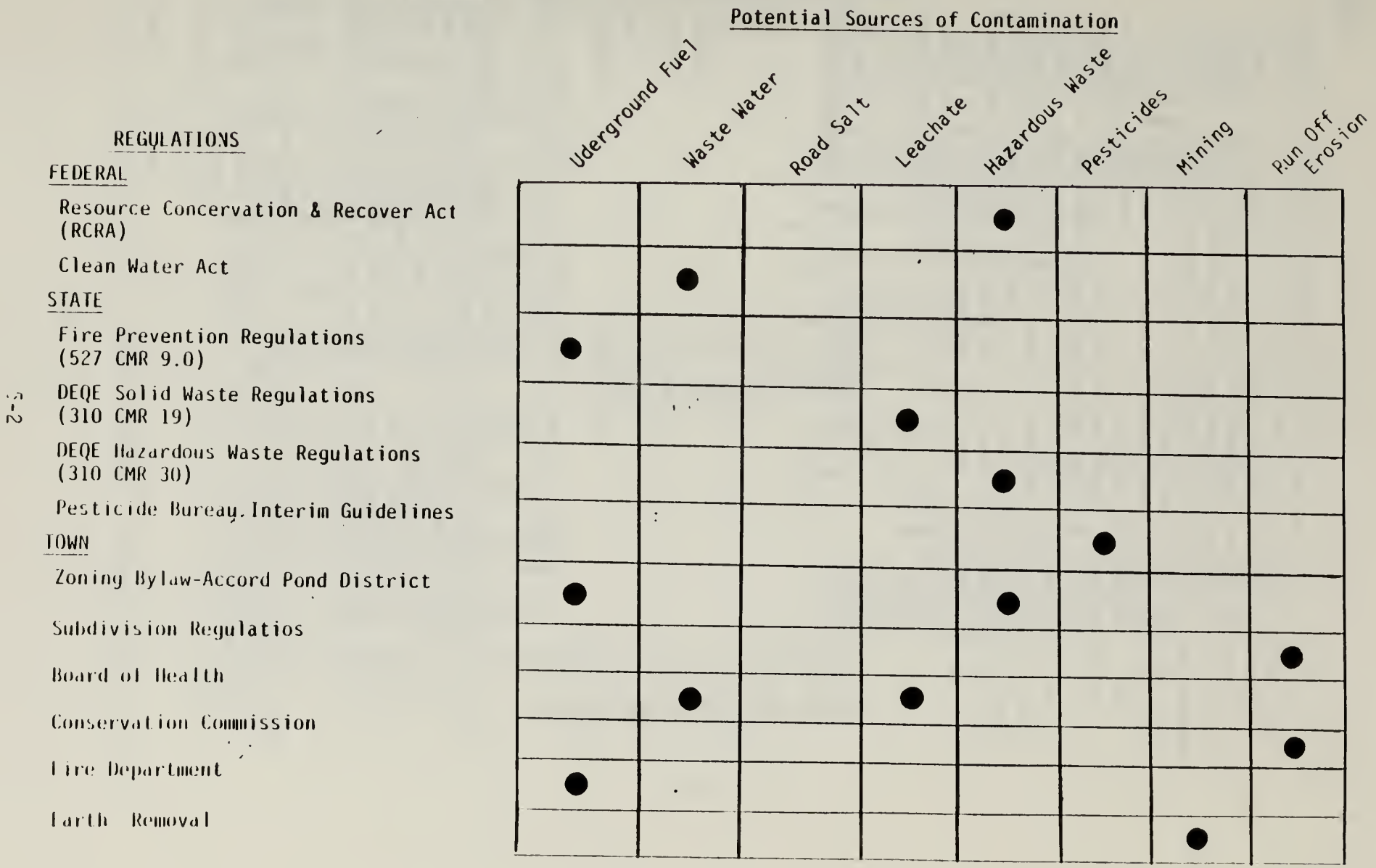


Figure 5-2

Hingham Board of Health Regulations

Hingham Board of Health Regulations - Sanitary Sewage

. Adopted as supplement to State Environmental Code (Title V). (Ch. 111 § 31, MGL.)

. Summary of major sections affecting groundwater:

§ 5- Requires compliance with Subdivision Control Law before permit may be granted.

§ 6- Requires installer to be qualified by experience or examination to satisfaction of Board of Health. Requires fee.

§ 7- Requires source of water to be secured & developed before permit may be granted.

§ 9- Plans must include:

(m) location of water courses, streams, lakes, swamps, marshes, floodplains & mean high tide line within 100' feet.

(n) location of existing or proposed water supply within 100' feet (Title 5-200 feet).

(o) water quality analysis of proposed water supply, & well drillers log.

§ 12- When existing building is altered, Board of Health must be notified of any increase in occupant capacity, and may require submission of plans conforming to requirements of new construction

§ 14- When existing building is altered so that greater volume of sewage is generated, work must conform to requirements for new construction.

§ 20- Sets a rate of 100 gallons per person for determining daily sewage flows; two persons per bedroom.

§ 21- Requires drainage to avoid standing water & soil saturation on the lot in vicinity of dwelling or septic system.

§ 22- Where constructed in fill, the fill must be compacted or settle for 6 months. (Title 5-12 months)

§ 23- Septic system must be located on same lot as dwelling/building served by it.

§ 26- Minimum 50 foot setback from spring high water level of any pond, stream, brook, swamp, wetland, or mean high tide line. Minimum elevation of bottom of leaching facilities - five (5) feet above mean high tidal water. Minimum 100 foot setback from private well, or 150 foot setback from surface public water supply or tributary thereto.

Setback Requirements (feet)

Distance from:	Hingham Board of Health	State Title 5
Private well		
Septic Tank	100	50
Leaching field	100	100
Watercourse		
Septic Tank	50	25
Leaching field	50	50
Public Surface Water Supply		
Septic Tank	150	50
Leaching field	150	100

§ 28- Septic tank minimum size 1500 gallons (title 5- 1000 gallons).

§ 43- Requires observation pit to determine maximum groundwater elevation.

§ 45- Board of Health review of all subdivision preliminary plans. Requires percolation test and soil observation pits (8 feet deep, one per acre). Board of Health may approve or disapprove preliminary plan.

§ 46- Board of Health review of all subdivision definitive plans. Requires plan with: 2 foot contour intervals, streams, ponds, wetlands, bedrock outcrops, drainage. Requires percolation test & test excavation four (4) feet below bottom of leaching system (one per acre) Board of Health may approve or disapprove definitive plan.

- Federal. Industrial wastewater discharges are regulated by the Clean Water Act, which sets standards for discharges through the National Pollution Discharge Elimination System (NPDES) Permit Program. (The NPDES program is implemented jointly by the EPA and the State DEQE. The state has applied for delegation authority.) There are two NPDES permitted discharges in Hingham. The Merriman Division of Litton Industries discharges noncontact cooling water to surface lagoon at its site in southwestern Hingham, which is not in the watershed of the town's water supply sources. The second NPDES permit is held by Spencer Press on Industrial Park Road. Like Merriman, this is also outside the watershed of Hingham's water supplies. However, it is in the basin of the Old Swamp River, which is tributary to Weymouth's Whitmans Pond, which provides 20 percent of that town's water supply. Recently Spencer Press has submitted an application to extend its NPDES permit for 5 years. The permit allows the discharge of 500 gallons per day (monthly average), with a daily maximum of 800 GPD. The pollutants regulated by the permit, and effluent limitations, follow:

Effluent Characteristic	Average Monthly	Maximum Daily
Flow	500 GPD	800 GPD
BOD	15.0 mg/l	15.0 mg/l
TSS	20.0 mg/l	30.0 mg/l
Amonia	75.3 mg/l	91.8 mg/l
Chromium	0.22 mg/l	0.22 mg/l
Copper	0.12 mg/l	0.12 mg/l
Silver	0.006 mg/l	0.006 mg/l
Zinc	2.1 mg/l	2.1 mg/l
Cyanide	0.092 mg/l	0.092 mg/l

The permit would also allow for discharge of noncontact cooling water, which occurs twice yearly.

- State/Local. Disposal of sanitary waste water is regulated by the Board of Health under the State Environmental Code (Title 5) and the town's Board of Health regulations on septic systems. The regulations set requirements for the siting and construction of on-site septic systems (see Figure 5-20). The town has adopted several measures which are more stringent than the state minimum standards, including wider setbacks from water supply sources.

  However, there are also two local health regulations which are less stringent than Title 5. Section 9 (n) requires plans to show the location of all water supplies within 100 feet of the disposal system. The Title 5 standard is 200 feet. Section 22 requires fill to be compacted or allowed to settle for six months. Title 5 requires 12 months.

  Equally important to maintaining water quality is the proper operation and maintenance of septic systems. Periodic inspection

is necessary, and the septic tank must be pumped out when greases and solids accumulate. The town has recently adopted a bylaw which requires the inspection of the septic system at the time of sale of a home.

Road Salt

There are no bylaws or regulations governing the application of road salt in Hingham. The area around Accord Pond is not salted.

Leachate

- Federal. No regulations concerning sanitary landfills.

- State. Landfills are operated under the DEQE regulations (310 CMR 19.00). These cover site selection, construction, cover material, litter and dust control, drainage of surface water, and completion and final cover of the landfill.

  New state regulations have been drafted which afford much greater protection to groundwater. The new regulations require an impervious liner, groundwater monitoring, runoff guidance, and landfill capping. Although not formally adopted as state regulations, DEQE has been applying the standards of the new regulations to most new or expanded landfills.

- Local. The Board of Health has responsibility for assigning sites for sanitary landfills and transfer stations. The Board also has general powers (under Chapter 111) to protect the public health.

- Federal. Hazardous waste generation, treatment, storage, transportation, and disposal are regulated by the Resource Conservation and Recovery Act (RCRA). The EPA has delegated authority to the state of Massachusetts to carry out the program.

- State. The Massachusetts Hazardous Waste Management Act (Chapter 21C) and the DEQE hazardous waste regulations (310 CMR 30) establish a system of stringent control over hazardous wastes. All waste generators are registered, and all wastes produced are accounted for in a "cradle-to-grave" manifest system. All wastes must be handled by licensed haulers and disposal facilities. There are standards for facilities which treat, store, and dispose of hazardous wastes. Waste generators are classified as Large Quantity Generators if they generate over 1,000 kilograms per month of non-acutely hazardous wastes. Quantities of waste above the Large Quantity threshold must be removed from the site within 90 days.

- Local. The Zoning Bylaw includes restrictions on toxic and hazardous substances within the Accord Pond Watershed Protection District. Within this District, a Special Permit is required for the use of Toxic or Hazardous Substances, and their discharge is prohibited.

Pesticides

- Federal. The EPA tests pesticide products and approves their use, with label instructions for proper use.

- State. Guidelines for right-of-way maintenance are being developed by the Pesticide Bureau of the Department of Food and Agriculture.

  Two sets of interim guidelines have been issued governing herbicide application. One regulates herbicide use on ballast areas of railroad layouts, and the other addresses herbicide use on both railroad layouts and utility rights-of-way. Both sets of guidelines restrict applications of pesticides to within 400 feet of wells or surface water supplies, including tributary streams. Krenite is to be used between 50 and 400 feet of a water supply source. A 100 foot buffer is to be left on either side of a railroad ballast where it crosses a stream tributary to a surface water supply.

- Local. There are no town bylaws or regulations concerning application of pesticides.

Mining. (Sand & Gravel Excavation)

- Federal/State. There are no state or federal regulations governing sand and gravel excavation.

- Local. Article V-E of the zoning bylaw includes Earth Removal Regulations. A special permit for earth removal must be obtained from the Board of Appeals. Operations must not "have a material adverse affect on the water supply, public health, or safety." Permit conditions may specify the area and depth of excavation, however no specific standards are established in the bylaw. The bylaw also stipulates that operations must not "result in a change of topography or cover which will be disadvantageous to the most appropriate use of the land."

ZONING

The preceding section summarized the laws and regulations which affect existing land uses in the town. Zoning determines the type and intensity of development which may occur in the future within defined districts of the town. As such, it is one of the most important tools at the town's disposal to insure the long-term protection of its water supplies. By defining critical water resource areas and restricting future land uses within those areas, the town can insure that incompatible or hazardous land uses do not threaten groundwater quality in the future. Sound management of the land use in the watershed area will not only protect the public health, it will also help prevent a contamination incident which could cost the town millions of dollars in treatment and clean-up costs.

Hingham's zoning bylaw is summarized below, with a focus on those aspects which could affect water resources.

ZONING DISTRICTS

In Hingham, the 28 acre aquifer area falls within portions of six zoning districts (see table 5-1). Three of these districts are residential, and

comprise about 2,135 acres or 75 percent of the aquifer area. Open space, which includes town and water company land, covers about 700 acres or 25 percent of the acquifer area. Open space, which includes town and water company land, covers about 700 acres or 25 percent of the acquifer. There are two small business districts, totaling about 17 acres, which represents less than one percent of the aquifer area. Each of the zoning districts is described below, and the major features of each are summarized in Figures 5-4 and 5-5.

Table 5-1
Zoning of the Aquifer Area

District	Area in Aquifer (Acres)	Percent of Aquifer Area	Minimum Lot Size
Residence A	365	13	20,000
Residence B	950	33	30,000
Residence C	820	29	40,000
Business A	2	---	---
Business B	15	---	---
Official and Open Space	700	25	---
TOTAL	2,852	100	

Figure 5-5
Zoning Analysis- Water Supply Impacts

Zoning District	Uses Allowed By Right	Uses Allowed By Special Permit	Potential Water Supply Impacts
Residence	Residence Professional Office Home Occupation Agriculture Church, School Government	Livestock Hospital Hospital Nursing Home Public Utilities	Septic systems Underground fuel Pesticides Fertilizers Household hazardous Urban runoff
Business	Retail Professional Office Auto Dealership Warehouse Printer Greenhouse Public Utilities Church, School Government	Hospital Nursing Home Service Station Auto Repair Apartment House	Septic systems Hazardous materials Underground fuel Urban runoff
Official and Open Space	Agriculture Church, School	Government Public Utilities	Septic systems Underground fuel Pesticides Fertilizers

Figure 5-4

Hingham Zoning Bylaw

Intensity Regulation

IV-B INTENSITY REGULATIONS

Use	Minimum Lot Size	Maximum Lot Coverage by Buildings	Special Requirements
Residence A	20,000	-	Maximum 50% of lot in Floodplain & Watershed District.
Residence B	30,000	-	Maximum 50% of lot in Floodplain & Watershed District.
Residence C	40,000	-	Maximum 50% of lot in Floodplain & Watershed District.
Residence D (town house)	5,000+	20%	Maximum 20% of lot in Floodplain & Watershed District.
Residence D (other than town house)	30,000	-	-
Business A	-	-	-
Business B	-	25%	-
Industrial	80,000	40%	Site plan reveiw for projects over 50,000 sq. ft. floor area.
Industrial Park	2 acres	40%	Site plan reveiw for projects over 50,000 sq. ft. floor area. Minimum 15% of lot not paved or built on.
Office Park	5 acres	0.15 floor area ratio	Site plan review. 80% of lot open & unbuilt on, may include driveways, parking.
Official & Open Space	-	10%	

Residential. The residential districts comprise 75 percent of the aquifer area. They include Residence A, (20,000 square foot lots), Residence B (30,000 square foot lots), and Residence C (40,000 square foot lots). In addition to residences, other uses allowed by right include professional offices, home occupations, agriculture, churches, schools, and government buildings. Uses allowed by special permit include hospitals, nursing homes, public utilities, and livestock operations.

The potential impacts on water supplies of the residential districts include reduction of groundwater recharge due to impervious surfaces; use of road salts, pesticides, and fertilizers which can introduce contaminants into groundwater, wastewater effluent from septic systems, and underground storage of heating oil. Improper disposal of household hazardous wastes may also pose a threat to groundwater.

Business. Within the aquifer area, only about 17 acres are zoned for business. This includes one parcel zoned Business A and one zoned Business B. Uses allowed by right in these districts include professional offices, retail stores, auto dealerships, wholesale warehouses, greenhouses, printers, public utilities, churches, schools, and government buildings. Uses allowed by special permit include auto repair/service stations, hospitals, nursing homes, and apartment houses. These uses could potentially impact groundwater with septic system effluent, underground fuel storage, hazardous materials, and urban runoff. However, due to their small size and remote location with respect to the wells, these districts do not pose a significant threat to the water supplies.

Official and Open Space. This district includes town owned lands such as conservation land, schools, and government buildings, as well as state parks, and privately owned open space. Within the aquifer area, 25 percent of the land is open space, mostly owned by the town and the Hingham Water Company. Uses allowed by special permit include public utilities and government buildings.

In general, this zoning district benefits groundwater protection by preserving open space in the aquifer area. However, some of the uses permitted could have water quality impacts associated with septic systems, underground fuel storage, and the use of pesticides and fertilizers.

Industry, Industrial Park. These districts are not present in the aquifer area, although they are within the Weir river watershed. Permitted uses include light manufacturing, warehouses, offices, auto dealerships, printers, freight terminals, and public utilities.

These districts could potentially impact groundwater quality with wastewater, hazardous materials, underground fuel storage, and urban runoff. However,due to their small size and remote location in the watershed, they do not currently pose a significant threat to water supplies.

Accord Pond Watershed Protection District. The town of Hingham has adopted a zoning overlay district to protect its surface water supply, Accord Pond. The area covered is in the southwest corner of the watershed, but it is not within the aquifer area (see Figure 5-7). The bylaw prohibit all discharges of toxic and hazardous substances in the district and requires a special permit for the storage of toxic and hazardous substances (including petroleum products). Tanks must meet standards for corrosion resistance, and periodic leak testing is required. The provisions of the bylaw are summarized in Figure 5-6.

Floodplain and Watershed Protection District. The town of Hingham has a Floodplain and Watershed Protection District which restricts development in floodplain areas (see figure 5-5). The bylaw prohibits dumping, filling, or excavation which will reduce natural flood storage or alter drainage in floodplains. Uses allowed by right include conservation, recreation, forestry, farming, and pasture. Uses allowed by special permit include municipal works, dams, excavations, drainage works, and roads. Existing buildings are exempted by the bylaw.

Residential Cluster Development. Hingham's zoning bylaw includes a provision for cluster development in the Residence A, B, and C districts. All applications for cluster development must be reviewed by the Board of Appeals and the Planning Board, and must meet the requirements of the subdivision regulations, Board of Health septic regulations, and the Conservation Commission. The bylaw requires that a minimum of 40 percent of the lot be preserved as open space.

SUBDIVISION REGULATIONS

Under Hingham's subdivision regulations, all Definitive Plans must be reviewed by the Board of Health, which reports to the Planning Board its approval or disapproval of the plan. The Board of Health makes findings as to which, if any, of the lots cannot be used for building sites without injury to the public health. Every building lot must either be connected to a municipal sewer system or be provided with a sewage disposal system approved by the Board of Health.

The subdivision regulations also require adequate drainage systems for disposal of surface water. Specific design standards for subsurface drains, storm drains, culverts, and open drainage systems are provided. The Planning Board may also require soil surveys where appropriate to establish the suitability of the land for proposed storm and sanitary drainage systems.

The subdivision regulations do not include any provisions which require consideration of the impacts of development on groundwater resources.

CONCLUSIONS

Hingham's existing zoning bylaw and subdivision regulations provide protection to surface water resources through measures such as the Accord Pond Watershed Protection District, the Floodplain and Watershed Protection District, and subdivision regulations on site drainage. However, no special protection is provided for the aquifer which supplies about two-thirds of the town's water. The current zoning in the aquifer

Figure 5-6

Hingham Zoning Bylaw

Accord Pond Watershed Distict

§4 Requires Special Permit for use of Toxic or Hazardous substances in the watershed, except uses in existence on 4/25/83.

§5 Prohibits Discharge of toxic & hazardous substances.

§6 Requires special permit for storage in tanks, except pre-existing tanks and storage gas/diesel/heating/lube oil as regulated by § 12. Storage incident to residential use prohibited.

§7 Requires Special Permit for Storage: of Toxic and Hazardous substances, as per § 12.

§8 Exempts: (i) disposal of sanitary wastewater not containing toxic or hazardous wastes; and (ii) residential Use, Storage & Discharge of household products generally available in retail stores & in quantities normally used by a single family, even if Toxic or Hazardous.

§9 All tanks are presumed to contain Toxic or Hazardous Substances & required to comply with this by-law.

§10 Requires tank leak testing: at installation; at 15 years old & annually thereafter upon evidence of discharge of Toxic & Hazardous Substance. Test to be approved by Building Commissioner.

§11 Special Permit - applicant must submit:
- . name, composition & quantity of substances
- . size, type, age, location of Tanks/Containers.
- . method of handling, time of Use or Storage, manufacturing processes; safeguards, spill prevention plan, inventory system, qualifications.
- . Notify Bd. of Health, Water Supply Committee & Fire Chief of any application for Use/Storage.
- . Board of Appeals may require additional data.

§12 Special Permit may be granted if:
- . storage is in Approved Tank/Container Storage.
- . applicant has experience & ability to operate facility
- . applicant has sufficient financial resourses to operate facility properly.

§15 Records concerning Use & Storage of Hazardous or Toxic Substances in Watershed shall be maintained by Building Commissioner, who shall assure that testing & inspection & special permit conditions are complied with.

area, which is 75 percent residential and 25 percent official and open space, with two small business parcels, protects the groundwater from the potentially significant threats of large-scale industrial and commercial development. However, analysis of the zoning presented here shows that even under residential zoning, significant threats to the groundwater may be permitted in the aquifer area. These include underground fuel tanks, hazardous materials associated with home occupations and households, pesticides and fertilizers associated with agricultural and residential land, and septic system effluent. In the next chapter, recommendations will be made to amend or add to existing local bylaws and regulations in order to increase the level of protection in the aquifer area.

CHAPTER 6

FINDINGS AND RECOMMENDATIONS

Introduction

This study has examined the potential water quality impacts of existing land uses and of potential future land uses permitted under the current zoning bylaw. Existing laws, bylaws, and regulations to control potential sources of contamination were reviewed, and their adequacy for groundwater protection was evaluated. In this chapter, new or amended bylaws and regulations will be recommended to strengthen the town's protection of its groundwater resources. These recommendations can be drawn together into a comprehensive groundwater protection program as outlined below.

GROUNDWATER PROTECTION PROGRAM

Zoning

- Findings. Hingham's Accord Pond Watershed Protection District provides protection to the surface water resources of Accord Pond through regulation of toxic and hazardous materials and underground fuel storage facilities. However, no such protection currently exists for the aquifer area which provides about two-thirds of the town's water supplies.

- Recommendations. The zoning bylaw should be amended to extend the protection of the Accord Pond Watershed Protection District to the entire aquifer area. A proposed zoning amendment is included in Appendix A. this amendment simply expands the jurisdiction of the existing Accord Pond Watershed District to the sand and gravel aquifer area mapped for the town by Weston Geophysical, Inc. This will provide regulation of toxic and hazardous materials and underground fuel throughout the watershed and aquifer area.

Earth Removal Regulations

- Findings. Excavation to a depth of less than ten (10) feet above the water table has potential impacts on groundwater quality and quantity. Excavation too close to the water table can also place constraints on development of other uses after excavation activities are terminated. This is especially true in unsewered areas, where any subsequent uses would have to rely on septic systems for wastewater disposal. The Hingham zoning bylaw includes earth removal regulations (Section V-E). These state that the area and depth of excavation may be specified as a permit condition, but no standards for excavation depth are included.

- Recommendations. The zoning bylaw should be amended to require that the maximum depth of excavation be at least ten (10) feet above the

seasonally high water table. The water table elevation should be determined on site by soil borings and test wells which are monitored through at least one high water season, from March 15 to May 15.

Underground Fuel Storage

- Findings. By virtue of state law, the town's regulation of fuel storage is divided between the Board of Selectmen and the Fire Chief. The selectmen issue licenses for gasoline storage over 165 gallons and fuel oil storage over 10,000 gallons. The Fire Chief issues permits for storage of lesser amounts of both fuels. As a result, the town's records of underground fuel facilities are not uniform and are divided between the tow authorities.

- Recommendations. All underground tanks within the aquifer area should be tested for leaks periodically, including residential underground fuel tanks. At a minimum, the town should create a uniform inventory of all new and existing underground fuel facilities. This data base could easily be computerized, which make updating convenient. The inventory could flag which tanks are located within the watershed and aquifer protection districts, and distance to a well or reservoir. This would allow tanks which pose a threat to water supplies to be identified and monitored more carefully.

- Findings. State underground fuel regulations (527 CMR 9.00) require leak testing. However residential tanks less than 1100 gallons are exempted from this requirement. These are typically older bare steel tanks with no protection against corrosion. As such, this may pose a significant threat to water quality. In Hingham, there are at least 105 of these tanks within the study area watershed. Of those, 53 are more than ten years old.

- Recommendations. All underground tanks within the aquifer area should be tested for leaks periodically, including residential underground fuel tanks. At a minimum, the town should adopt a bylaw which requires a professional leak test of all residential underground fuel tanks at the time of sale of any home within the aquifer protection district. This would increase the level of protection against a water quality threat which is otherwise exempted form regulation. A similar measure was adopted by Hingham requiring a septic system inspection at the time of sale of a home. A record of all inspections could be added to the underground fuel data base recommended above.

- Findings. Approval of all new underground fuel storage facilities now rests with the Board of Selectmen and the Fire Chief, as mandated by state law. However, because of the potential for environmental and water supply impacts, it would be advisable for several other boards to be notified of proposed tank installations and be given an opportunity to comment.

- Recommendations. A review procedure should be established whereby the Board of Health, Conservation Commission, Water Supply Committee, and the Building Commissioner are notified of all pending applications for underground fuel licenses or permits and given an opportunity to

comment. Such a procedure could be established with a bylaw, or by adopting a memorandum of understanding between the affected boards, the Fire Chief, and the Board of Selectmen. The review process would not in any way restrict the statutory authority of the Fire Chief or Board of Selectmen to issue permits or licenses. It would however provide the advice of the other boards, and insure that potential water quality impacts are considered in the licensing and permitting process.

Health Regulations

- Findings. A review of the town's supplementary health regulations revealed that two provisions are less stringent than the State Environmental Code, Title 5. Under the law, towns may adopt more stringent regulations, but Title 5 is considered the minimum standard.

- Recommendations. The Board to Health should amend its regulations to bring them up to the standards of Title 5. The two provisions are:

  Section 9(n), which requires all plans to include the location of existing and proposed water supplies within 100 feet of the sewage disposal system. The Title 5 requirement is 200 feet (310 CMR 15.02).

  Section 22, which requires fill to be compacted or allowed to settle for a minimum of six months. The Title 5 requirement is twelve months.

- Findings. According to a septic system survey conducted for the town by Metcalf and Eddy, there have been numerous septic system failures in Hingham, many of which have been in the aquifer area. This indicates the potential for groundwater impacts.

- Recommendations. Within the aquifer area, the Board of Health should strictly apply all sanitary regulations. The Board should also encourage more frequent inspection and pumping of septic systems through public education, especially in the aquifer area. The town should consider adopting an inspection and monitoring system, perhaps initially as a voluntary program.

- Findings. In some areas of the watershed, sandy soils allow a very rapid percolation rate, which may not permit adequate treatment of septic system effluent. The State Environmental Code requires a minimum percolation rate, but has no standards for a maximum rate.

- Recommendations. The town should adopt a local health regulation which requires a maximum percolation rate of two minutes per inch. This will prevent the excessively rapid infiltration of septic system effluent into the groundwater.

Subdivision Regulations

- Findings. The town's subdivision regulations contain many provisions for the regulation of surface runoff and drainage, but there are no provisions which take groundwater into consideration.

- Recommendations. The Planning Board should amend the subdivision regulations by adding a section which allows the board to require information on groundwater resources, impacts, and mitigation measures. This provision would be optional and applied in appropriate cases at the discretion of the Planning Board. It should allow the board to require such information as water table elevations, direction of groundwater flow, location of aquifers or recharge areas for public water supplies and analysis of open and closed drainage system alternatives, examining effects on the recharge of aquifers and the quality of groundwater. The provision should allow the board to require appropriate mitigation measures, such as contaminant removal employing detention basins, oil and grease separators, and other devices.

Household Hazardous Wastes

- Findings. Because of the residential nature of the aquifer area, there are numerous residential septic systems discharging to the ground in the aquifer and in close proximity to the wells. Properly operating septic systems can treat domestic sanitary wastes, but many "household hazardous wastes" disposed of in septic systems may travel unabated through the soil and enter the groundwater.

- Recommendations. The town should continue its household hazardous waste collections on an annual basis, taking advantage of state financial assistance when available. Publicity for the collections should especially focus on the aquifer and watershed protection districts. There should also be a public education effort to discourage the improper disposal of household hazardous wastes.

Intermunicipal Cooperation

- Findings. Hingham's water supply watershed extends into portions of Weymouth, Norwell, and Rockland. Activities in those portions of the watershed could affect Hingham's water supply. Likewise, a portion of Weymouth's watershed lies within Hingham.

- Recommendations. The town should seek to establish a cooperative agreement with Weymouth, Rockland, and Norwell regarding development in those communities which is within the watershed of Hingham's water supply sources. The agreement should include notification of Hingham of any proposed subdivisions or developments within the watershed, providing an opportunity for Hingham to comment on any potential water supply impacts during the review process. In the case of Weymouth, the agreement should be reciprocal regarding the portion of Hingham which is within Weymouth's water supply watershed. With the cooperation of the South Shore Coalition, MAPC will be conducting a regional water supply protection study in 1987. One goal of the study is to identify intermunicipal water supply issues, and to propose a regional cooperative mechanism for dealing with those issues. Hingham could take advantage of this program to effectuate better coordination with neighboring towns in the watershed.

APPENDIX A

Proposed Zoning Amendment
Accord Pond Watershed and Hingham Aquifer Protection District

Will the Town amend the Zoning By-Law of the Town of Hingham adopted March 10, 1941 as heretofore amended by amending Section II-D as follows:

1. Wherever in Section II-D the phrase "Accord Pond Watershed Protection District" is found, such phrase is deleted and in its place is substituted the phrase "Accord Pond Watershed and Hingham Aquifer Protection District", and wherever the term "Watershed" is found, such phrase is deleted and in its place is substituted the word "District".

2. Sub-section 2 is deleted and in its place is substituted the following: "The location and boundaries of the Accord Pond Watershed and Aquifer Protection District shall be as shown on a map entitled 'Zoning Map, Part C - Accord Pond Watershed and Hingham Aquifer Protection District, Town of Hingham, Massachusetts" dated November, 1986,filed in the Office of the Town Clerk, which map by this reference is incorporated herein and made a part of this Zoning By-Law."

3. There is added to the third line of the second paragraph of subsection 2 after the words "Accord Pond" the additional words "and of the Town's Aquifer area."

4. There is added to the third line of the second paragraph of subsection 2 after the words "Accord Pond" the additional words "and of the Town's Aquifer area."

5. Wherever in this By-Law, the date April 25, 1983 appears, there is added after such date the following: "or in the case of portions of the District added by this amendment, April ___ 1987."

6. The period appearing at the end of subsection 8 is deleted and in its place is added the following "and (iii) approved Container Storage of heating oil for use in heating buildings in which such containers are located and for use in heating buildings in which such containers are located and for which all necessary licenses or permits pursuant to Chapter 148 have been obtained and remain in force and effect."

or Act on anything related thereto?

FIGURE 3-1

HINGHAM

Environmentally Sensitive Areas

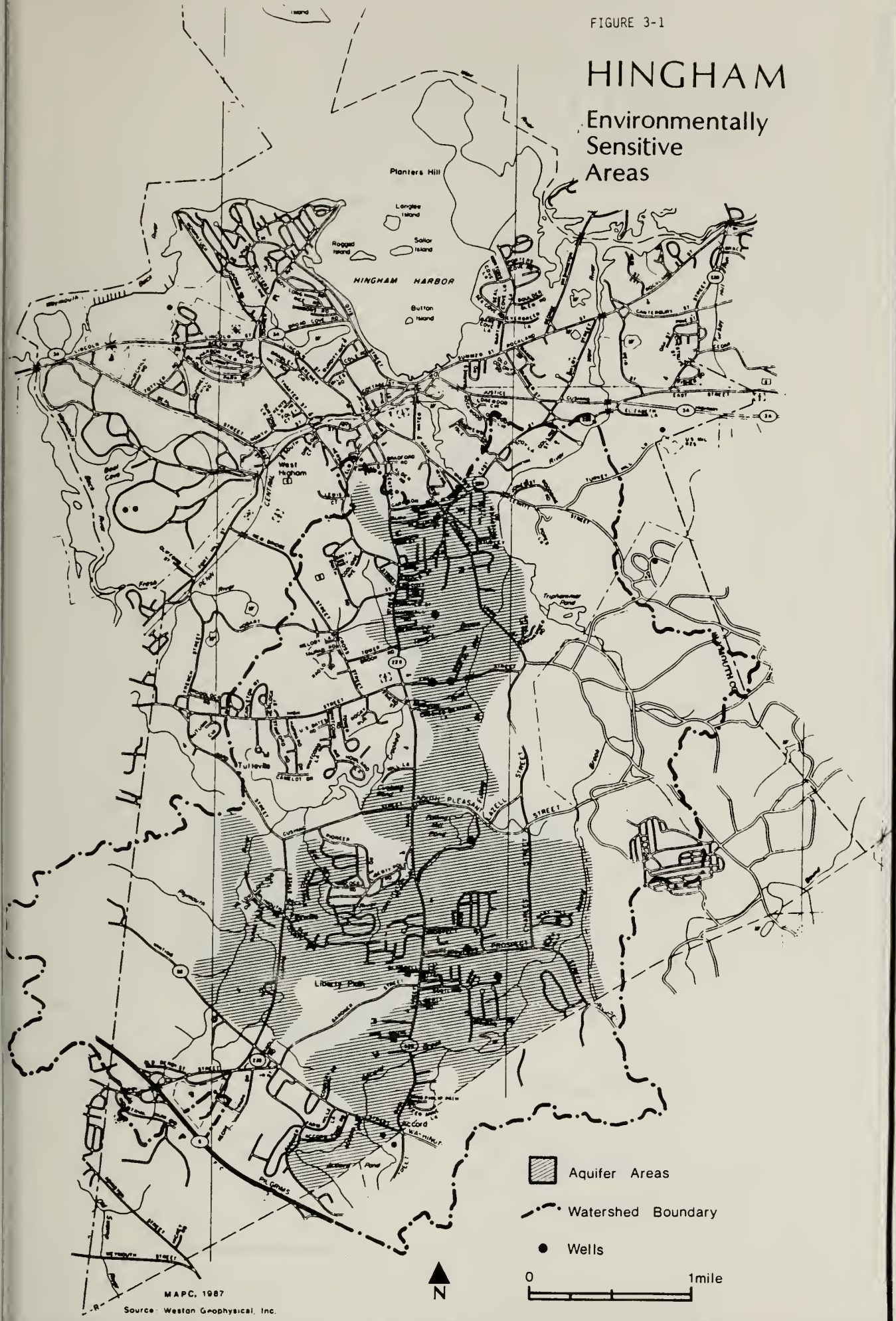
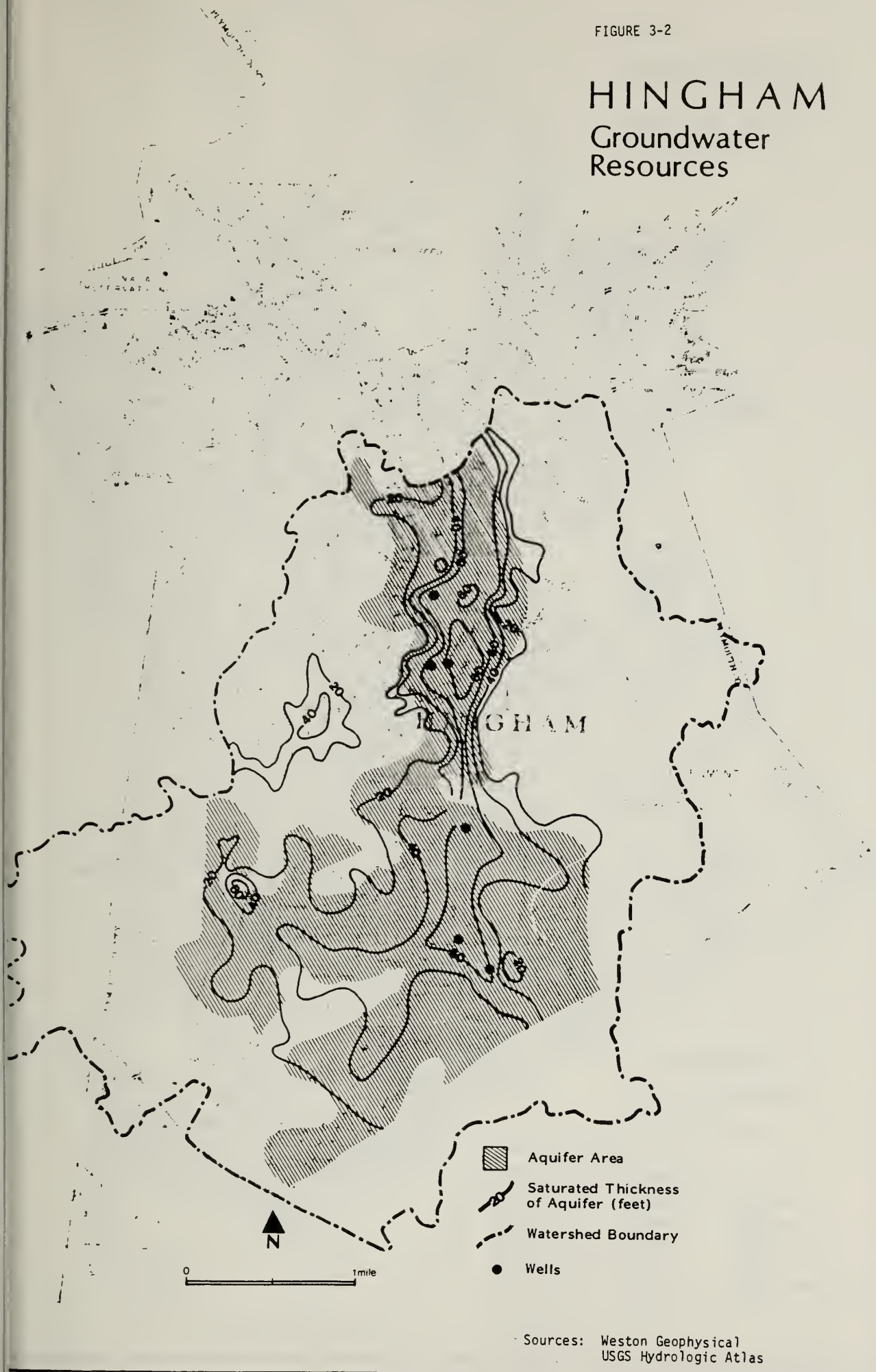


FIGURE 3-2

HINGHAM
Groundwater Resources

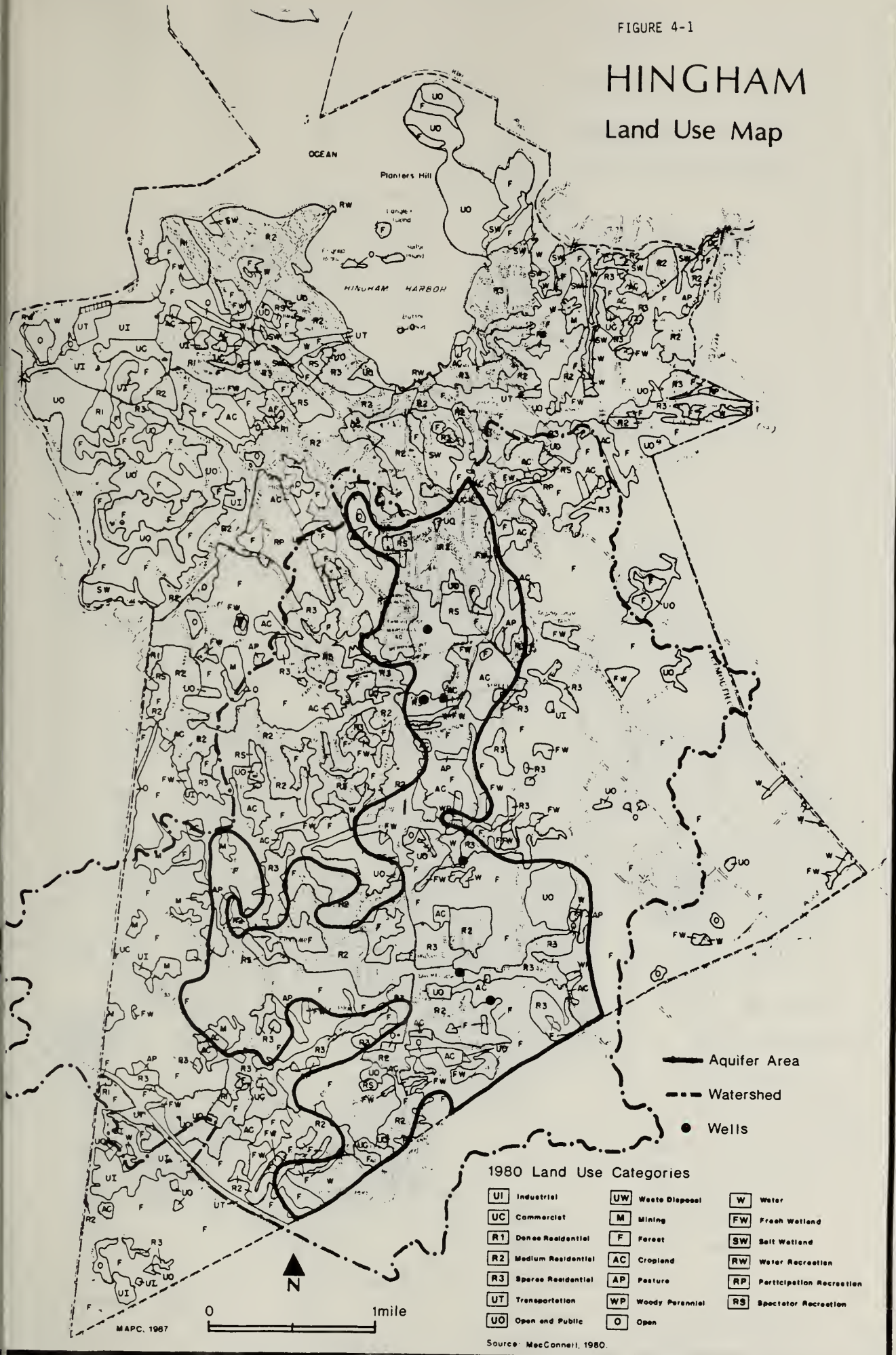


Sources: Weston Geophysical
USGS Hydrologic Atlas

FIGURE 4-1

HINGHAM

Land Use Map

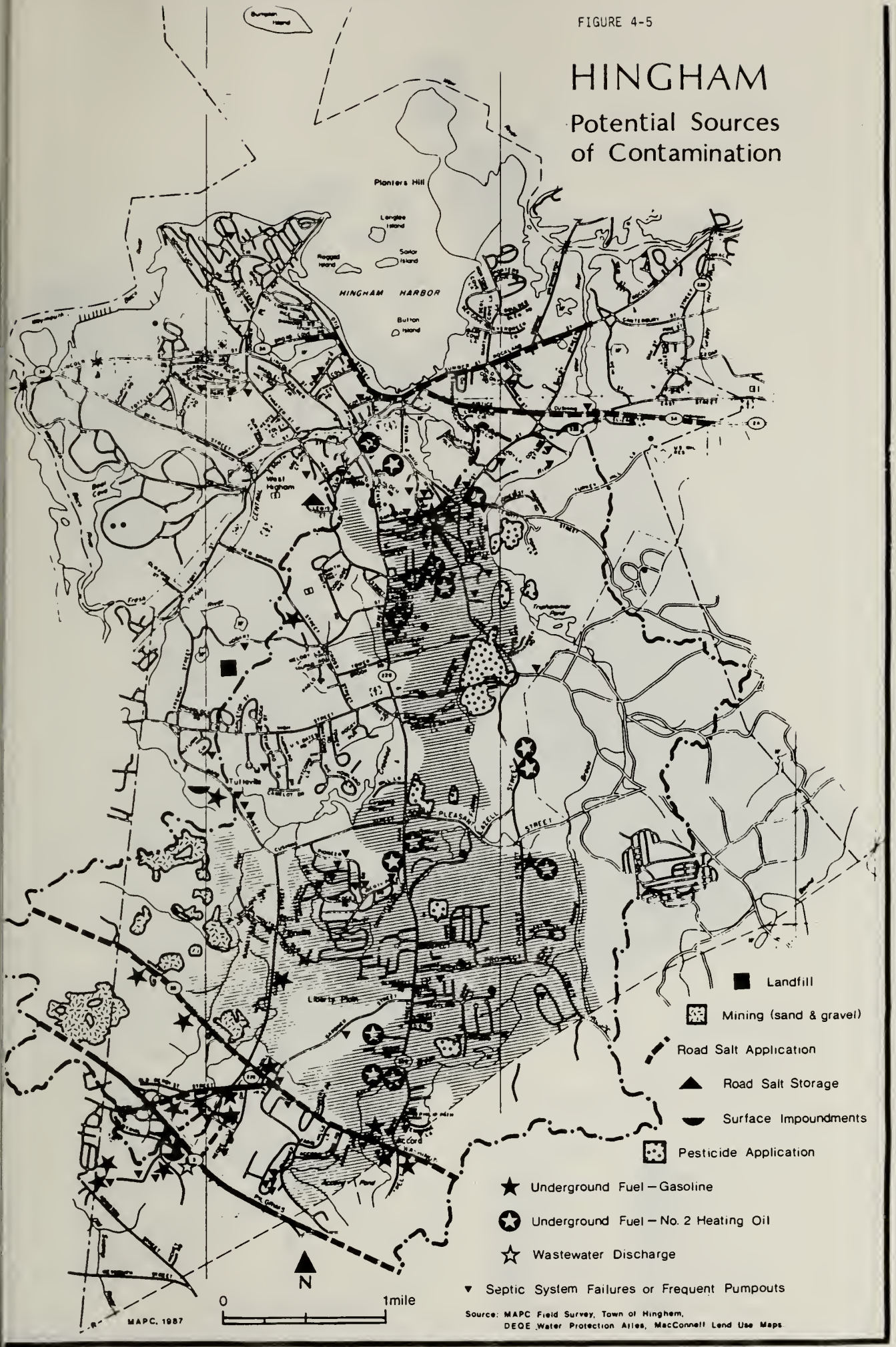


Source: MacConnell, 1980.

FIGURE 4-5

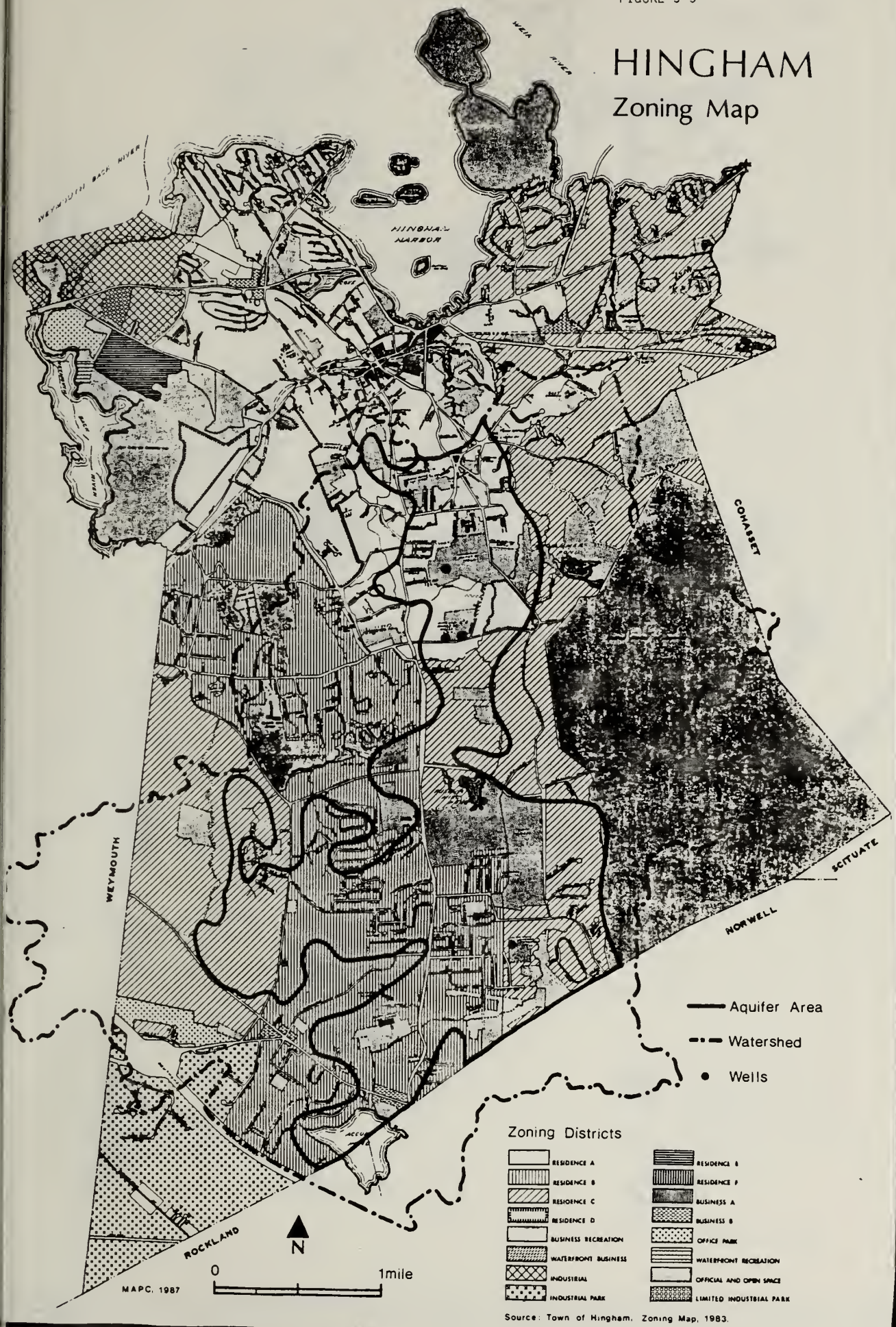
HINGHAM

Potential Sources of Contamination



Source: MAPC Field Survey, Town of Hingham, DEQE Water Protection Atlas, MacConnell Land Use Maps

FIGURE 5-3



Source: Town of Hingham, Zoning Map, 1983.


HINGHAM
Zoning Map
WEYMOUTH
NORWELL
ROCKLAND
0 1600 3200 4800
SCALE IN FEET
N
Wells
Flood Plain and Watershed Protection District
Accord Pond Protection District
Aquifer Area
Watershed Boundary


ZONING MAP - PART C
ACCORD POND WATERSHED
AND HINGHAM AQUIFER
PROTECTION DISTRICT
HINGHAM
HINGHAM HARBOR
Planters Hill
Langlee Island
Ridged Island
Sailor Island
Button Island
U.S. NAVAL RESERVATION
U.S. NAVAL RESERVATION
West Hingham
U.S. GOVERNMENT RESERVATION
PLYMOUTH CO
Liberty Plain
Accord
Aquifer Protection District
Accord Pond Watershed Protection District
0 1600 3200 4800
SCALE IN FEET
N